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EXHAUST EMISSIONS CHARACTERISTICS OF FIVE AIRCRAFT PISTON ENGIN--ETC(U)
MAR 79 K J STUCKAS DOT-FA74NA-1091

UNCLASSIFIED FAA/RD-78-88 NL

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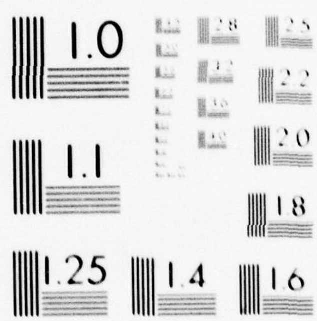

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Report No. FAA-RD-78-88

LEVEL II

EXHAUST EMISSIONS CHARACTERISTICS OF FIVE AIRCRAFT PISTON ENGINES

Kenneth J. Stuckas

FINAL REPORT

MARCH 1979

Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.

Prepared for

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16. Abstract

This report details the findings from a 27-month investigation under NAFEC Contract DOT FA74NA-1091 Phase I, to investigate the exhaust emission levels of five aircraft piston engines with respect to the 1980 EPA Emissions Standards. The work includes the development of procedures for the testing, measurement and calculation of emissions from these engines as well as the determination of emissions reduction potential from lean fuel-air ratio operation and spark timing variations. Practical limitations to lean operation are investigated and confirmation of these limits were sought through a flight test program on one of the engines.

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METRIC CONVERSION FACTORS

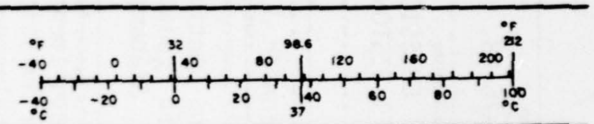
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

On June 28, 1974, Teledyne Continental Motors, Aircraft Products Division, under contractual agreement with the Federal Aviation Administration, National Aviation Facilities Experimental Center (NAFEC), began work on Contract DOT FA74NA-1091 for the purpose of evaluating the baseline exhaust emissions of five aircraft piston engines. In addition, the work was intended to explore the possibility of reducing these exhaust emissions by leaner fuel-air ratio operation and ignition timing changes, within the limits of safe operation of the engines.

The Contract effort was a consequence of the Environmental Protection Agency Regulation published on July 17, 1973, in Volume 38, Number 136, Part II, of the Federal Register entitled "Control of Air Pollution from Aircraft and Aircraft Engines".

While this study supplements previous work done by Teledyne Continental Motors, Scott Research Labs and the Bendix Corporation Research Labs, its major contribution lies in two principal areas. First, and most importantly, estimates derived from test stand operation define expected safe limits of lean operation for the five engines in terms of cooling and acceleration (References 14 - 18). The second area of importance involves the development of an accurate analysis for the calculation of the required mass emission values.

Throughout the duration of the Contract intensive development has been necessary to improve the accuracy, repeatability and durability of the exhaust emissions measurement system. The success of these developments has been due to the persistent efforts of Mr. Arthur G. Hufton.

The data reduction analysis was formulated by Mr. Bernard J. Rezy and Contract coordination was provided by Mr. William A. Anderson.

Acknowledgement is also due to Mr. John R. Black for his work in the collection of data and to Mr. J. Ronald Tucker for his assistance with data assessment for this report.

The flight test portion of this Contract was conducted by Messrs. Bobby W. Minnis and Larry K. Anderson.

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1. INTRODUCTION

This report concludes a 27 month effort under Phase I of the Contract, DOT FA74NA-1091. The purpose of this part of the Contract was to define the exhaust emission levels of five aircraft piston engines manufactured by Teledyne Continental Motors, Aircraft Products Division, and to explore possible emissions reduction through variable ignition timing and lean fuel-air ratio operation.

The engines tested are a representative cross-section of current production engines ranging from a small 4-cylinder carbureted engine to a complex 6-cylinder, geared, fuel-injected, turbocharged engine. The report shows the expected limitations of safe operation in the attempt to reduce exhaust emissions over a 7-mode Landing/Takeoff (LTO) Cycle.

An addition to the Contract in the form of a flight test program illustrates the difference between uninstalled propeller stand testing and installed testing over a 0 - 100°F ambient temperature range. This additional testing was deemed necessary to exemplify the differences between the actual installed and estimated test stand limitations on safety of flight of lean engine operation.

As a supplement to this report, the reader is directed to the individual engine reports written durin g the course of the Contract. References 14 - 18 give the titles and content of these reports which include log sheets with additional data not reported herein. This data includes items such as fuel temperature, crankcase pressure, fuel injection nozzle pressure, individual cylinder head temperatures (only maximum CHT is given in this report), oil temperature and other data not deemed critical to the understanding of aircraft piston engine exhaust emissions.

2. THE EXHAUST EMISSIONS STANDARDS

The Exhaust Emissions Standards for aircraft piston engines were established by the Environmental Protection Agency in response to Section 231 of the Clean Air Act, as amended by Public Law 91-604. The Regulations are published in Volume 38, Number 136, Part II of the Federal Register, dated Tuesday, July 17, 1973. In addition, an addendum was published in Volume 41, Number 181, Part I, dated Thursday, September 16, 1976. The addendum covers miscellaneous amendments to the original Regulations which do not substantially affect the work presented in this report.

The standards were partially based on the data in the Cornell Aeronautical Laboratory Technical Report CAL No. NA-5007-K-1 of October 15, 1971. The Report, which was prepared under EPA Contract No. 68-04-0040, is a compilation of data collected by Scott Research Laboratories and Teledyne Continental Motors. This compilation includes a statistical analysis of the available data. The Environmental Protection Agency concluded in the preamble to the Regulations that "sufficient evidence is already available in the form of measured emissions data on current aircraft to indicate that the proposed standards can be met by improved fuel management .....". The subject of this NAFEC Contract Report is the determination of what can be done with "improved fuel management" of existing engines.

Basically, the EPA Regulation states that for a 5-mode cycle of simulated airport operation (see Table 2-1), the exhaust emissions from each new aircraft piston engine manufactured on, or after, December 31, 1979, shall not exceed the specified limits for hydrocarbons, carbon monoxide and oxides of nitrogen. These limits apply to all aircraft piston engines, except radial engines (the Regulation does not include radial engines).

In addition, the exhaust emissions from each in-use engine manufactured on or after December 31, 1979, shall not exceed the level applicable to it when it was new.

So, not only must the engines manufactured in 1980 and beyond meet the Standard, but they must also maintain continuous compliance with the established limits.

For the purposes of the exploratory work under the Contract, and to compare the emissions from the five different engines which were tested, the EPA 5-mode LTO cycle was expanded into a 7-mode cycle by separating the Idle/Taxi modes and further defining the power/speed conditions of the remaining modes. Table 2-2 is the NAFEC Contract 7-mode LTO cycle which was used as the basis for all engines tested.

The EPA power/speed requirements for each mode were intended to give enough latitude to allow for the fact that typical LTO cycles will vary depending on the engine model tested. During the course of the Contract work it was found that some latitude was needed beyond the specific requirements of the NAFEC Contract 7-mode cycle. It is unreasonable, for instance, to operate a geared engine at 1200 propeller RPM for the Taxi mode. With the three-bladed, or large diameter two-bladed propellers used on these engines, 900 propeller RPM gives a more reasonable power level. Also, in the case of the O-200-A engine, the fixed-pitch propeller did not allow operation at the specific conditions required by the Take-Off, Climb and Approach Modes.

In this respect, the absolute values of exhaust emissions reported here relative to the 1980 EPA exhaust emissions Standards may not reflect the values obtained when consideration is given to the latitude offered by the EPA 5-mode cycle. Also, when the operating conditions are examined for each engine model as installed in a particular model airframe, the unique individual requirements may result in variations in the reported values. Nevertheless, the intent of this Report is to examine relative reductions in emissions and to demonstrate the relative emission levels of the five engines with respect to one another.

EPA FIVE-MODE LTO CYCLE

MODE NO.	MODE NAME	TIME-IN-MODE (min.)	POWER (%)	ENGINE RPM (%)
1	TAXI/IDLE OUT	12.0	***	
2	TAKE-OFF	0.3	100	100
3	CLIMB	5.0	75 to 100	***
4	APPROACH	6.0	40	***
5	TAXI/IDLE IN	4.0	***	
	TOTAL CYCLE	27.3		

TABLE 2-1

***Manufacturer's Recommended

NAFEC CONTRACT SEVEN-MODE LTO CYCLE

MODE NO.	MODE NAME	TIME-IN-MODE (min.)	POWER (%)	PROPELLER RPM
1	IDLE OUT	1.0	-	600
2	TAXI OUT	11.0	-	1200*
3	TAKE-OFF	0.3	100	100% of Maximum
4	CLIMB	5.0	80	90% of Maximum
5	APPROACH	6.0	40	87% of Maximum
6	TAXI IN	3.0	-	1200*
7	IDLE IN	1.0	-	600
	TOTAL CYCLE	27.3		

TABLE 2-2

*900 RPM for geared engines

3. BACKGROUND - THE AIRCRAFT PISTON ENGINE

In understanding the exhaust emissions characteristics of the aircraft piston engine and the problems unique to the measurement of emissions from such engines, it is necessary to be aware of the operational requirements and limitations of this class of internal combustion engines.

The five engines tested by Teledyne Continental Motors under the Contract represent the widest range of light aircraft piston engine types currently in production. Table 3-1 shows the variety represented by these five engines.

	O-200-A	IO-520-D	TSIO-360-C	TIARA 6-285-B	GTSIO-520-K
ENGINE DISPLACEMENT, in^3	200	520	360	406	520
RATED BRAKE HORSEPOWER	100	300	225	285	435
CARBURETED	X				
FUEL INJECTED		X	X	X	X
GEAR DRIVEN				X	X
TURBO-SUPERCHARGED			X		X

TABLE 3-1 ENGINES TESTED IN NAFEC CONTRACT DOT FA74NA-1091

Each aircraft piston engine model must meet the requirements of Part 33 of the Federal Aviation Regulations outlining the airworthiness standards to be met in obtaining a Type Certificate. The required testing includes vibration testing to define the vibratory characteristics of the crankshaft and propeller shaft under both steady-state and transient conditions, a calibration test to establish the power characteristics, a 150-hour endurance test, a detonation test and an operation test.

The engine model must also undergo additional testing by the airframe manufacturer as part of the aircraft certification procedure to demonstrate airworthiness of the engine/propeller/airframe combination. The compliance with Part 23 of the Federal Aviation Regulations includes fuel system, engine cooling, engine oil system and other testing.

The operating limitations of an aircraft piston engine are thus determined by an envelope of conditions which ensure the airworthiness of the total system. These boundaries and the tolerances applied to them are determined in large part by engine cooling requirements, detonation limits and smooth transient operation. Fulfilling these three basic criteria are primarily a function of the fuel system.

The cooling air available to the installed aircraft piston engine is limited by the forward speed of the aircraft. To some degree, variations in cooling capability with the available ram air pressure are possible through the design of efficient engine cowling, inter-cylinder baffling and variable cowl flaps. When maximum advantage is taken of these factors then the fuel system must be limited to a minimum fuel flow schedule at higher powers to prevent cylinder overheating. Figure 3-1 shows an approximate relationship between cylinder head temperature, exhaust gas temperature, engine power and specific fuel consumption with fuel-air ratio.

For the full power requirement of take-off, it is obvious that a range of fuel-air ratios between .0765 - .0835 will provide the maximum available power. For other operational modes not requiring maximum available power such as climb, taxi, idle, approach and cruise, the desired range of fuel-air ratios is that which provides best fuel economy (.059 - .066). The limitations on leaning the engine to this best economy range are cylinder head temperature, turbine inlet temperature (for a turbocharged engine), smooth transient operation (engine acceleration) and detonation.

For the special case of a turbocharged engine, it is often not possible to achieve proper cylinder head cooling at best power fuel-air ratio in the maximum power condition due to high specific power output and limited cooling air pressure. Under these conditions, reduced cylinder head temperatures are achieved by the rich operation of the engine resulting in slightly lower power and lower cylinder head temperatures.

During the Type Certification process, all these limits must be demonstrated so that safety margins can be established and the fuel system can be designed to provide the required fuel flow schedule for safe engine operation.

As an example, Figure 3-2 shows the recommended fuel flow versus brake horse-power curve that was a result of the calibration and detonation tests on the TSIO-360-C engine. The shaded area shows the permitted region of operation. Note that above 75% power, the fuel flow schedule becomes richer (higher fuel flow) than best power fuel flow. This enrichment provides the required cooling and detonation margin for the engine operating at higher powers. The rich and lean limits of full rich fuel flow are established such that every production fuel system may be adjusted to remain within these upper and lower limits when operated full rich. Below the 75% power level, manual leaning is permitted to a fuel flow providing an EGT value which is 50°F rich of peak.

A safety margin is provided beyond these established limits to account for the variations in fuel-air ratio with ambient temperature, pressure and humidity as well as the reduction of the detonation limit with engine age due to combustion chamber deposit build-up.

Each engine model is Type Certificated within its own established set of limits deemed necessary for safety of flight. This envelope then determines the limits on exhaust emissions for each engine within the specification of its Type Certificate.

This report explores the limits of exhaust emissions within the current Type Certificates of the five engines based on a 7-Mode Landing/Take-Off (LTO) cycle of airport operation. Exploration beyond these established safe boundaries is also presented in terms of spark timing variations and lean operation to the limits of smooth transient operation or cylinder head overheating.

Throughout the report, reference will be made to the exhaust emissions at three specific operating conditions. BASELINE operation refers to the nominal full-rich fuel flow as specified by the Type Certificate of a particular engine at a particular operating condition. This represents the normal operation of current aircraft piston engines through an LTO cycle near an airport.

CASE 1, refers to the leanest (lowest fuel flow) operation permitted in each of the operating modes within the current Type Certificate for the engine.

CASE 2 represents the estimated leanest possible operation of the engine within cylinder head temperature and smooth transient operating limits.

The actual engine tests which were conducted on a propeller test stand are only estimates of installed behavior. A flight test was conducted using the IO-520-D engine installed in a Cessna 210 aircraft. The flight tests were conducted over a wide range of ambient temperatures to attempt to define the practical CASE 2 limits of this engine.

In operating an engine on a propeller test stand, the operating range is somewhat limited by the nature of the propeller/engine combination. The O-200-A engine was designed to operate with a fixed-pitch propeller resulting in its range of operation being limited to a propeller load curve. The flight propeller used during testing on this engine is not capable of developing full rated power (100 BHP) statically, so the maximum power developed on the stand was about 80 BHP. This limitation will not significantly affect the overall LTO cycle emissions, as the full power Take-Off Mode represents only one percent of the total cycle time.

The remaining engines were equipped with constant-speed (variable pitch) propellers operated by a hydraulic governor. The governor and mechanical stops can be adjusted to allow full power to be developed statically. Below about 35% power, however, the propeller remains in full flat pitch and acts like a fixed-pitch prop. In an actual aircraft installation the propeller is adjusted statically to a lower speed so that in actual flight with relative motion between the air and the propeller, full power RPM is developed. The result of these discrepancies is that the emissions levels measured on the prop stand are not identical to those which would be measured in actual installed use in an aircraft.

Another complicating factor, which results in data variability, is that the propeller is an aerodynamic device. At a given engine speed, the propeller will require varied engine throttle settings from day to day due to the normal changes in atmospheric density. The result is some amount of emissions data scatter particularly in the low-power idle mode.

Also, due to the insensitivity of the fuel injection systems to air flow variations, exhaust emissions will vary, at constant fuel flow, with normal excursions in atmospheric humidity, temperature and pressure.

For each of the five engines a recommended fuel flow versus corrected brake horsepower curve is presented from the Detail Model Specification for each engine. These curves, similar to Figure 3-2, are based on a propeller load curve, so that for each power condition there is one corresponding speed based on the theoretical relationship,

$$\frac{BHP_2}{BHP_1} = \left(\frac{RPM_2}{RPM_1}\right)^3$$

The engines are operated at a manifold pressure and speed corresponding to the NAFEC Seven-Mode LTO Cycle which would ideally give the percent power required by Table 2-2 at Standard Day conditions (60°F, 29.92 in. Hg), according to the Detail Model Specification. A plus or minus 2.5% of nominal corrected power, at full power, is allowed to account for production variability. As a result, observed engine power will vary for the Take-Off, Climb and Approach Modes with ambient conditions and engine age.

The exhaust emissions test results in Sections 4.1 thru 4.5 of this report are presented in light of the particular operating characteristics and restrictions for each engine model.

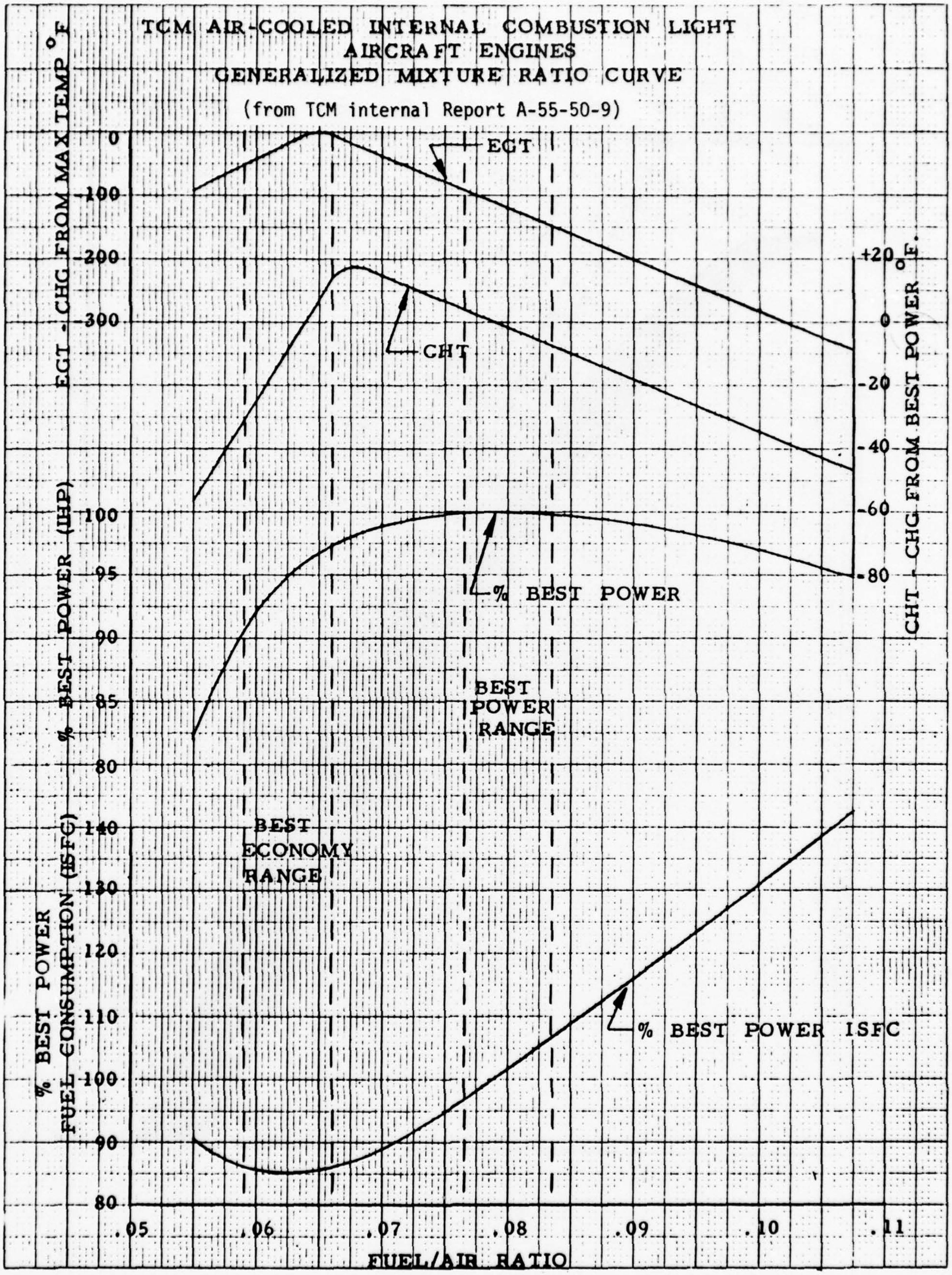

TCM AIR-COOLED INTERNAL COMBUSTION LIGHT AIRCRAFT ENGINES
GENERALIZED MIXTURE RATIO CURVE
(from TCM internal Report A-55-50-9)
EGT - CHG FROM MAX TEMP °F
0
-100
-200
-300
EGT
CHT
+20 °F.
0
-20
-40
-60
-80
CHT - CHG FROM BEST POWER
% BEST POWER (IHP)
100
95
90
85
80
% BEST POWER
BEST POWER RANGE
BEST ECONOMY RANGE
% BEST POWER FUEL CONSUMPTION (ISFC)
140
130
120
110
100
90
80
% BEST POWER ISFC
.05
.06
.07
.08
.09
.10
.11
FUEL/AIR RATIO

FIGURE 3-1

TSIO-360-C

RECOMMENDED FUEL FLOW VERSUS BRAKE HORSEPOWER

(from "Detail Specification For TCM Aircraft Engine Model TSIO-360-C")

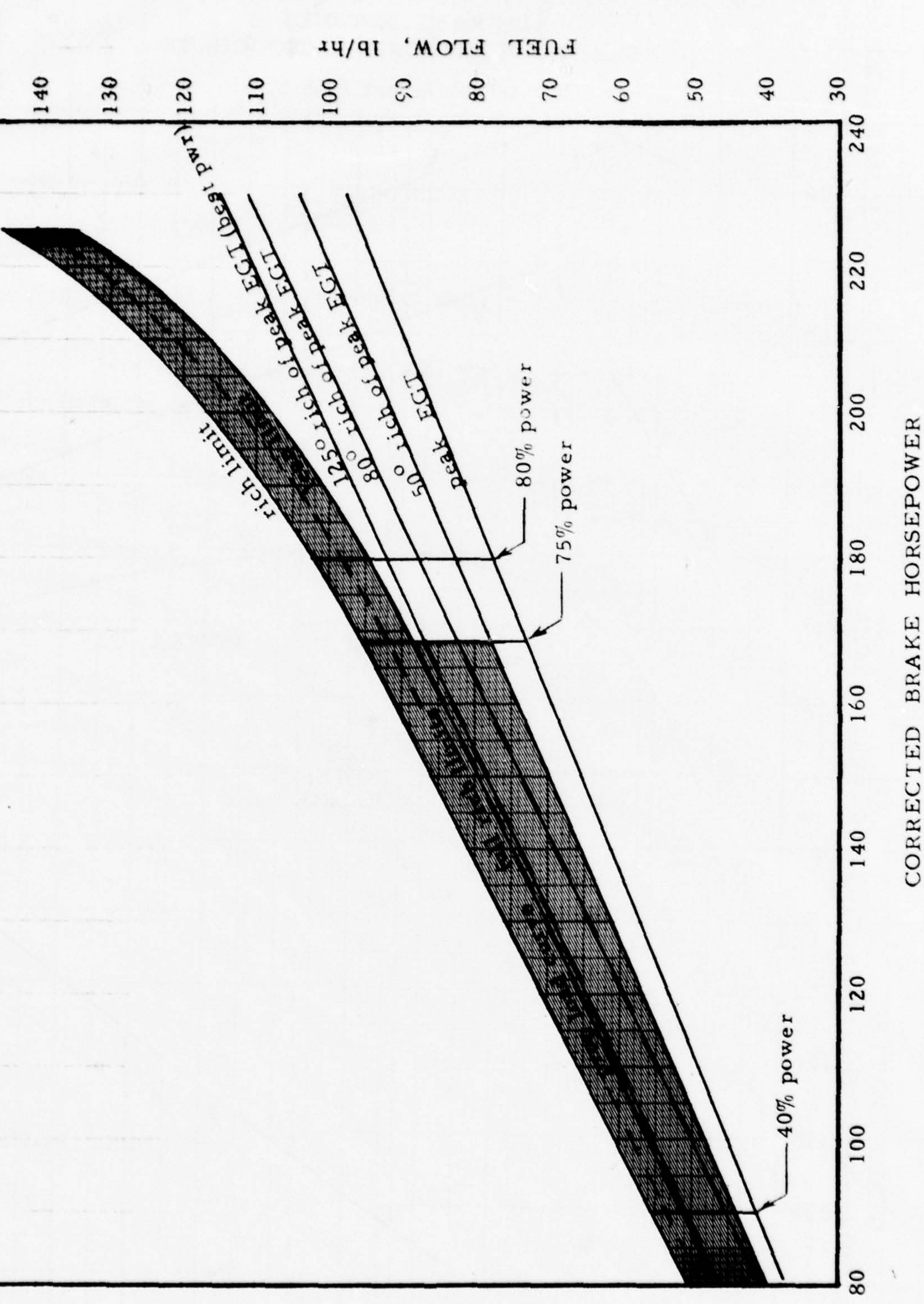


FIGURE 3-2

4. EXHAUST EMISSIONS TEST RESULTS

This Section presents the emissions results from each of the five (5) engines tested under the Contract. An attempt has been made to present the information for each engine in a standard format for ease of comparison. Each sub-section will begin with a brief description of the engine, its particular operating requirements and a discussion of test technique and special problems encountered during testing. For the most part, the emissions results are presented graphically at the end of each sub-section and reference will be made to each table or figure as it is discussed in the text. Reference should be made to Appendices C thru G for additional data.

4.1 0-200-A Exhaust Emission Test Results

At 100 Horsepower, the 0-200-A engine is the smallest aircraft piston engine currently produced by TCM. A carbureted, four cylinder, horizontally opposed engine, the 0-200-A is in widespread use in General Aviation training aircraft. Over 22,000 units of this model have been produced to date.

This engine was the first one tested under the Contract, and, as a consequence, problems were encountered with the data due to exhaust emission measurement system inadequacies. Following the completion of testing on the five engines, the 0-200-A was rerun and this data was used for establishing the emissions levels for this engine. In Figures 4.1-2 thru 4.1-7 the original data is presented for comparison. A chronological list of the exhaust emissions measurement system problems are presented in Reference 4, p. 375. Figure 4.1-1 shows the recommended fuel flow schedule for this engine, where average full rich fuel flow is defined as BASELINE, and the lean limit and minimum allowable fuel flow boundaries define CASE 1. These limits are individually defined in Figures 4.1-2 thru 4.1-7.

For the Idle, Taxi and Approach modes, the limit on CASE 2 minimum fuel flow was selected on the basis of engine acceleration requirements. Take-off and Climb (both at 80% power) minimum fuel flows were established by the cylinder head temperature considerations.

The flight propeller used on this engine was a McCauley two-blade, fixed-pitch propeller (S/N 41130), which was not capable of turning the required 2750 RPM statically. Full power was not developed during the Take-off Mode. Since this mode represents only one percent of the total cycle, the overall cycle emissions are not affected to any great extent.

Also, due to the nature of the fixed-pitch propeller, the Approach was not run at 40% power and 87% RPM but rather at 40% power and 71% RPM.

Figure 4.1-8 shows the results in terms of percent of EPA Standards for the BASELINE, CASE 1 and CASE 2 conditions. The 0-200-A engine was not able to meet the Standard for carbon monoxide (CO) or hydrocarbons (HC), while remaining within its current Type Certificate (CASE 1). Even when operated to CASE 2 fuel flows, the engine exceeded the Standard for CO by 21%. In all cases, oxides of nitrogen (NO_x) remained below the Standard.

Figure 4.1-9 shows the distribution of each of the three pollutants over the 7-Mode LTO cycle. The production of CO and HC were primarily in the Taxi Out, Climb and Approach Modes, while NO_x was produced in significant quantities only during lean operation in the Climb and Approach Modes.

The data presented in Figures 4.1-8 and 4.1-9, as well as the similar figures for the remaining four engines, does not represent a specific test, but rather an average level derived from the individual engine lean-out curves, such as Figures 4.1-2 through 4.1-7 for the O-200-A engine.

During all engine testing, the induction air inlet pressure was maintained at 29.92 inches of mercury absolute pressure, corrected to a dry (zero humidity) condition by boosting that inlet pressure by an amount equal to the vapor pressure of the humidity in the air. Hence, the term "inches of mercury absolute, dry" has been used to denote induction (combustion) air inlet pressure. This procedure is used during Type Certification Calibration Testing, and is used here as well. A study was done to estimate the effect of induction air pressure variations due to normal atmospheric pressure fluctuations on the exhaust emissions of the O-200-A engine. The results shown in Figures 4.1-10 thru 4.1-13 indicate that for this carbureted engine with a fixed pitch propeller, increases in ambient pressure lead to decreases in fuel-air ratio (more air for the same fuel flow) with corresponding decreases in CO and HC values.

The spark timing variations for this engine were run primarily at BASELINE fuel flows. No significant improvement or degradation of emissions were noted over the cycle for the variations in magneto timing from 26° to 34° BTC.

TABLE 4.1-1

O-200-A ENGINE DESCRIPTION

TYPE CERTIFICATE NUMBER	252
DATE OF ISSUANCE	3/5/58
NUMBER OF CYLINDERS	4
CUBIC INCH DISPLACEMENT	200.91
CYLINDER BORE (inches)	4.0625
PISTON STROKE (inches)	3.875
COMPRESSION RATIO	7.0:1
DRIVE RATIO (propeller/crankshaft)	1:1
AIR INDUCTION SYSTEM	NATURALLY ASPIRATED
FUEL CONTROL SYSTEM	CARBURETED
RATED MAXIMUM TAKE-OFF POWER	100 BHP
RATED MAXIMUM TAKE-OFF PROPELLER RPM	2750 RPM
RATED MAXIMUM CONTINUOUS POWER	100 BHP
RATED MAXIMUM CONTINUOUS PROPELLER RPM	2750 RPM
MAXIMUM ALLOWABLE CYLINDER HEAD TEMPERATURE	525°F
MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE	--
MINIMUM FUEL OCTANE RATING	80/87 Avgas
IGNITION TIMING (degrees btc)	28°

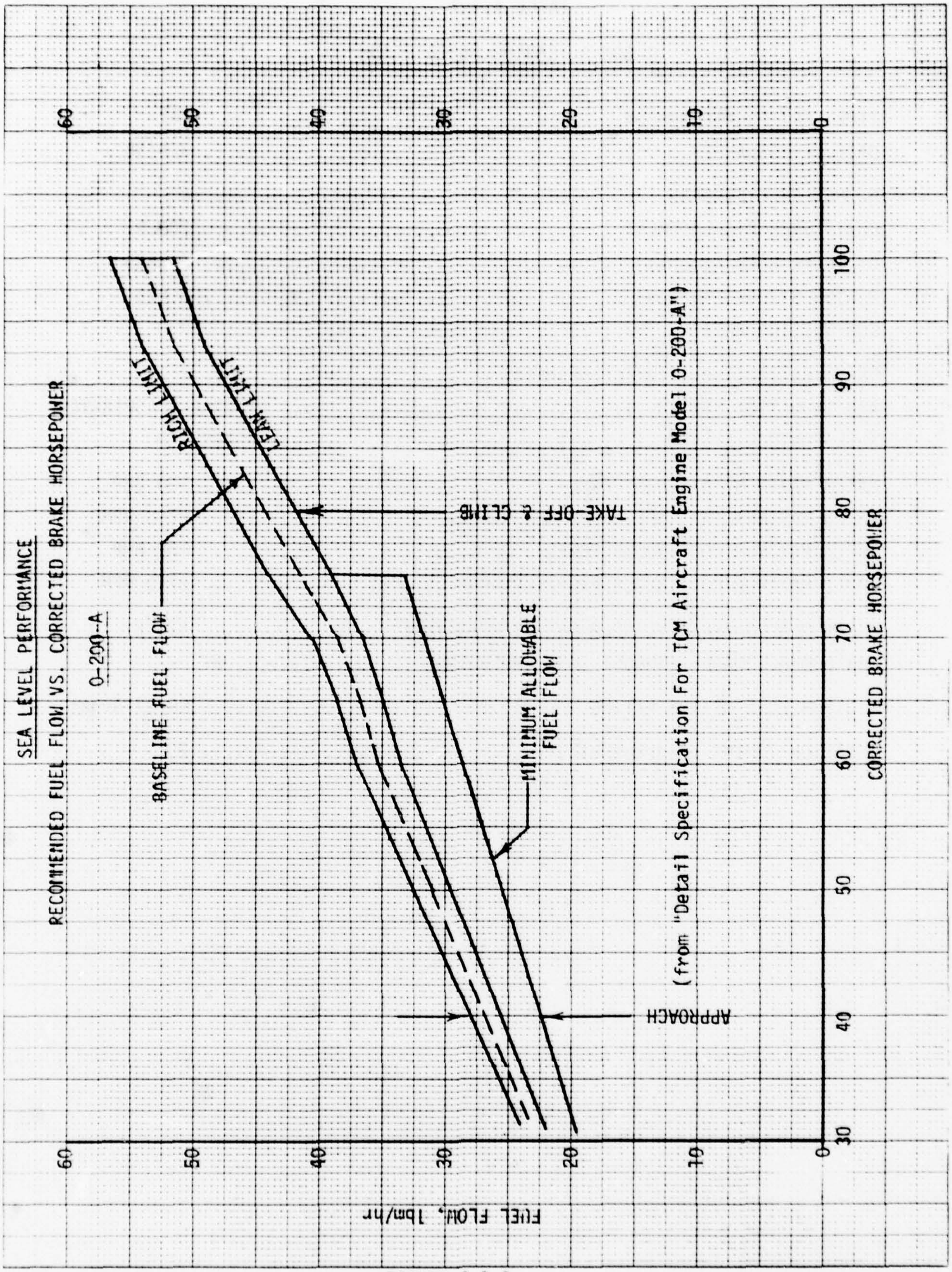

SEA LEVEL PERFORMANCE
RECOMMENDED FUEL FLOW VS. CORRECTED BRAKE HORSEPOWER
0-200-A
BASELINE FUEL FLOW
RICH LIMIT
LEAN LIMIT
TAKE-OFF & CLIMB
MINIMUM ALLOWABLE FUEL FLOW
APPROACH
(from "Detail Specification For TCM Aircraft Engine Model 0-200-A")
FUEL FLOW, lbm/hr
CORRECTED BRAKE HORSEPOWER
0
10
20
30
40
50
60
30
40
50
60
70
80
90
100

FIGURE 4.1-1

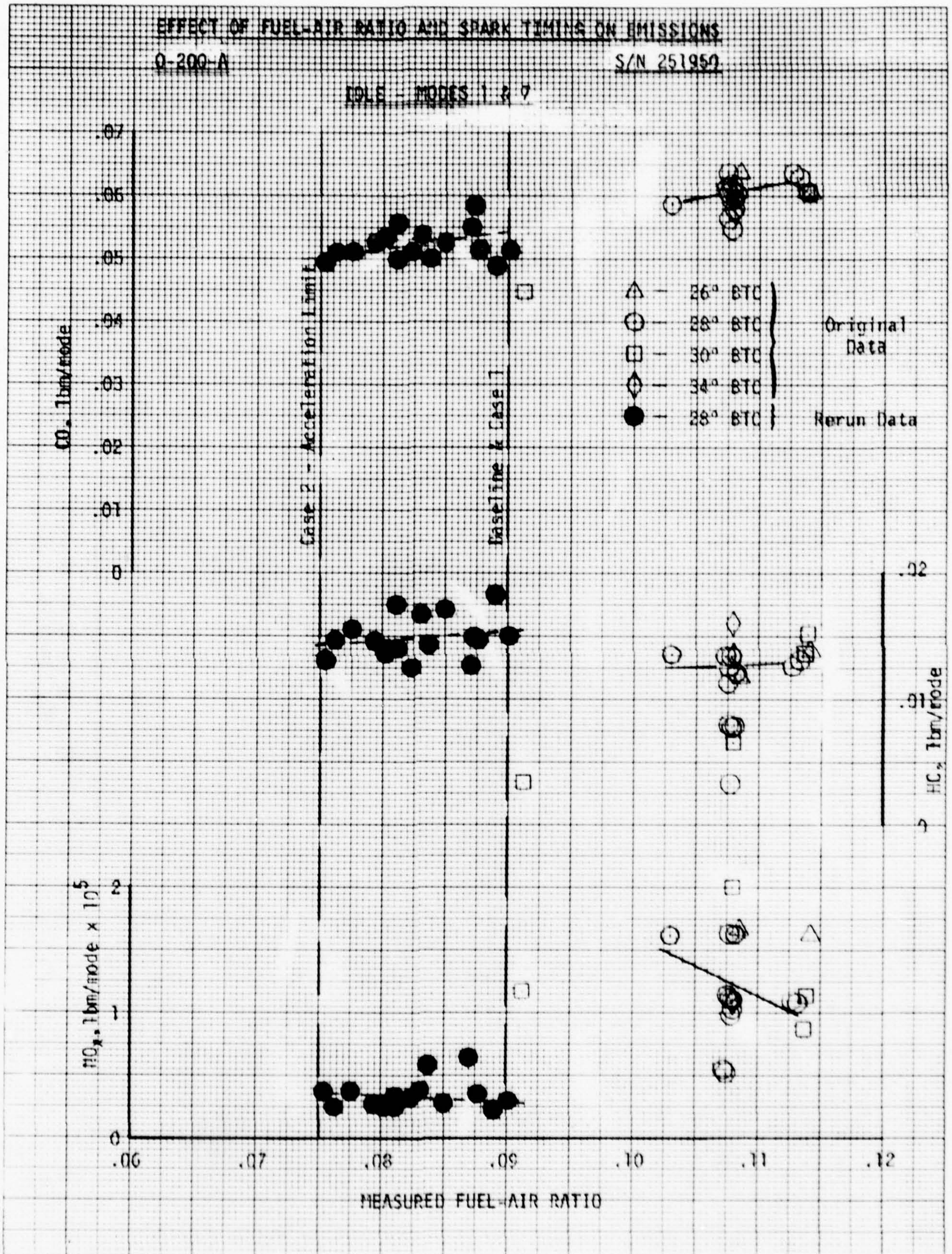
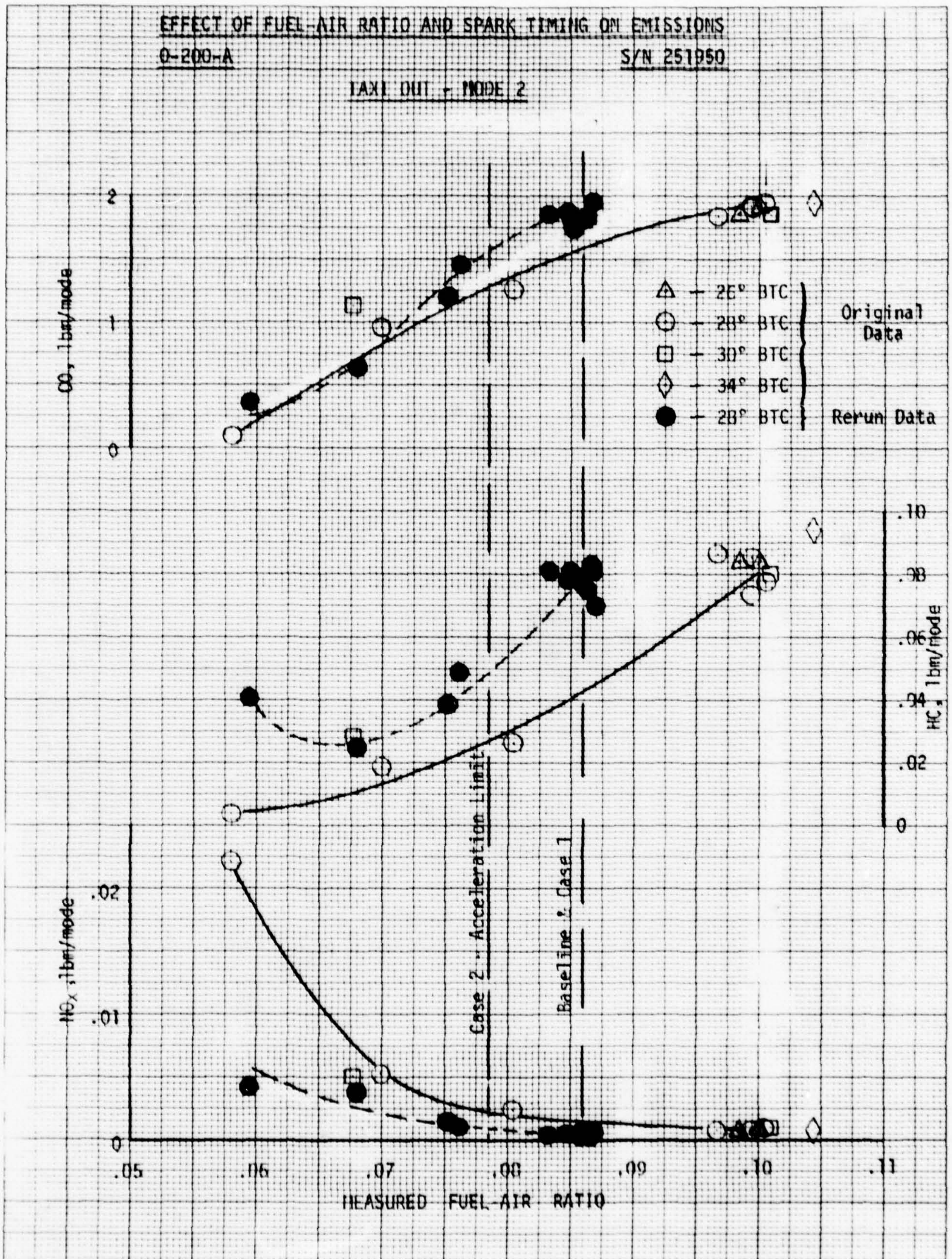
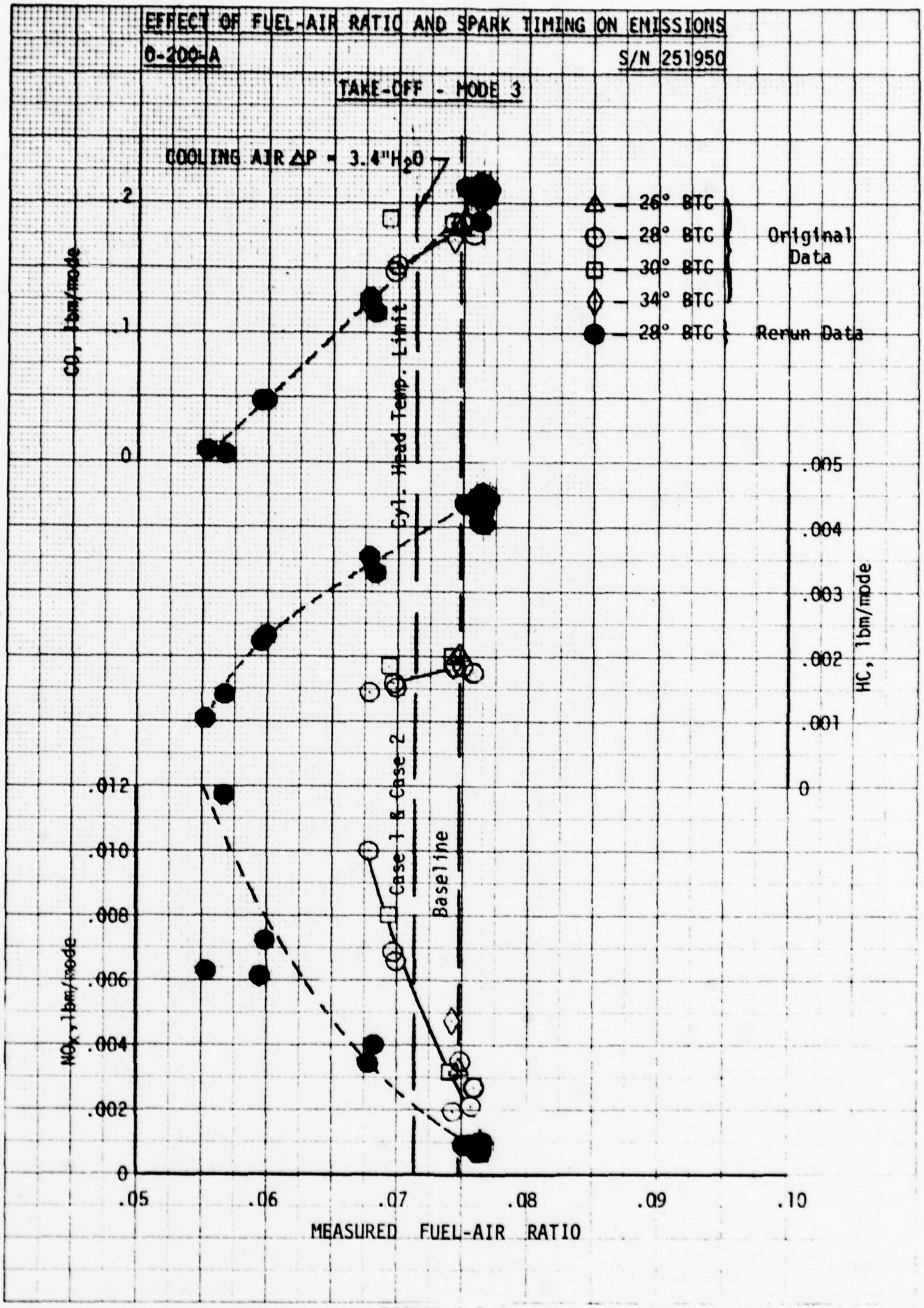

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
O-200-A
S/N 251950
IDLE - MODES 1 & 7
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode × 10^5
Case 2 - Acceleration Limit
Baseline & Case 1
26° BTC
28° BTC
30° BTC
34° BTC
28° BTC
Original Data
Rerun Data
MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10
.11
.12
.07
.06
.05
.04
.03
.02
.01
0
.02
.01
0
2
1
0

FIGURE 4.1-2



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
0-200-A
S/N 251950
TAXI OUT - MODE 2
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
26° BTC
28° BTC
30° BTC
34° BTC
28° BTC
Original Data
Rerun Data
Case 2 - Acceleration Limit
Baseline - Case 1
MEASURED FUEL-AIR RATIO

FIGURE 4.1-3



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
0-200-A
S/N 251950
TAKE-OFF - MODE 3
COOLING AIR ΔP = 3.4"H_2O
26° BTC
28° BTC
30° BTC
34° BTC
Original Data
28° BTC
Rerun Data
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
Cyl. Head Temp. Limit
Case 1 & Case 2
Baseline
MEASURED FUEL-AIR RATIO
.05
.06
.07
.08
.09
.10

FIGURE 4.1-4

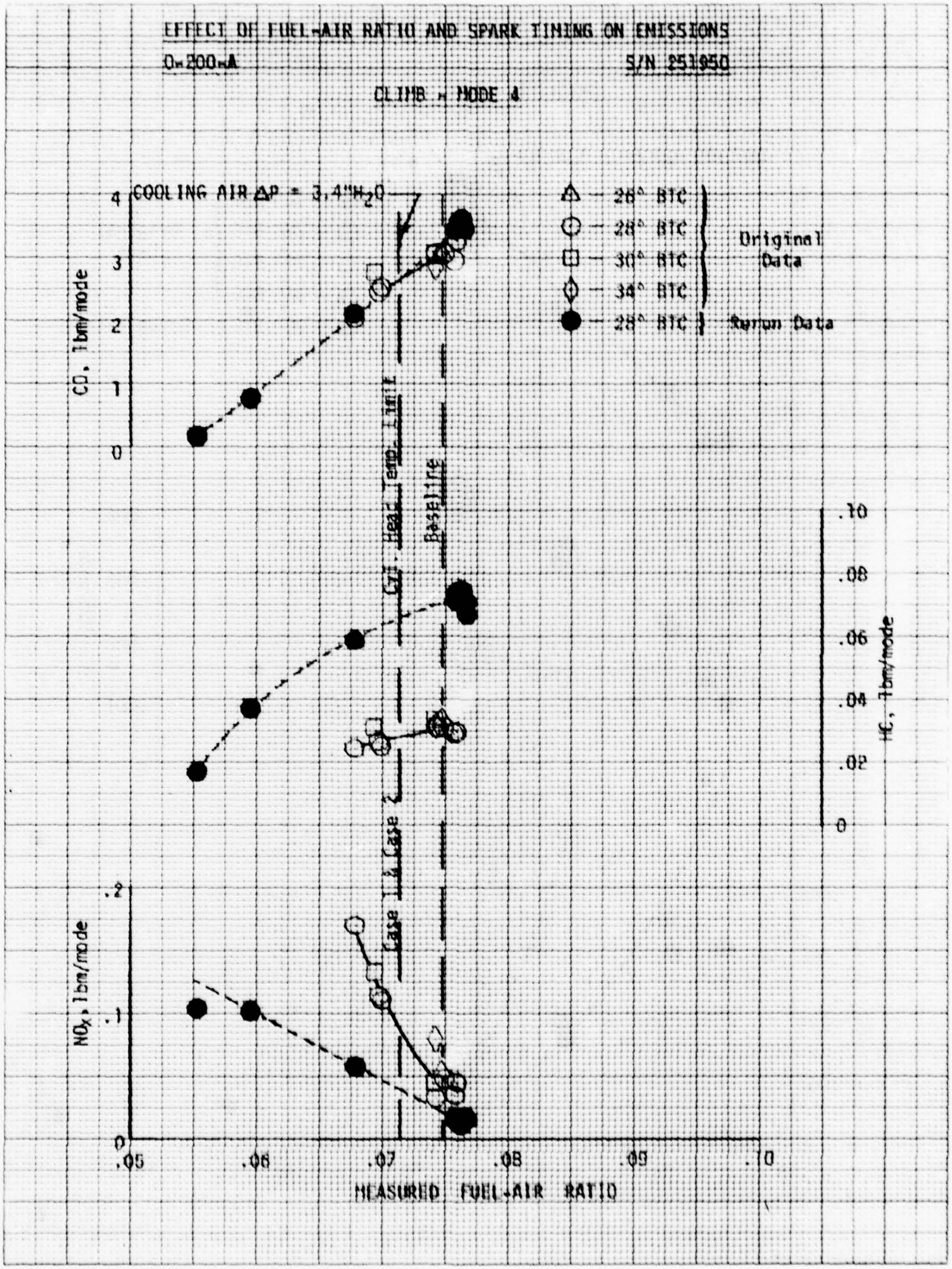

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
O-200-A
S/N 251950
CLIMB - MODE 4
COOLING AIR ΔP = 3.4"H_2O
26° BTC
28° BTC
30° BTC
34° BTC
Original Data
28° BTC
Rerun Data
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
Cyl. Head Temp. Limit
Baseline
Case 1 & Case 2
MEASURED FUEL-AIR RATIO

FIGURE 4.1-5

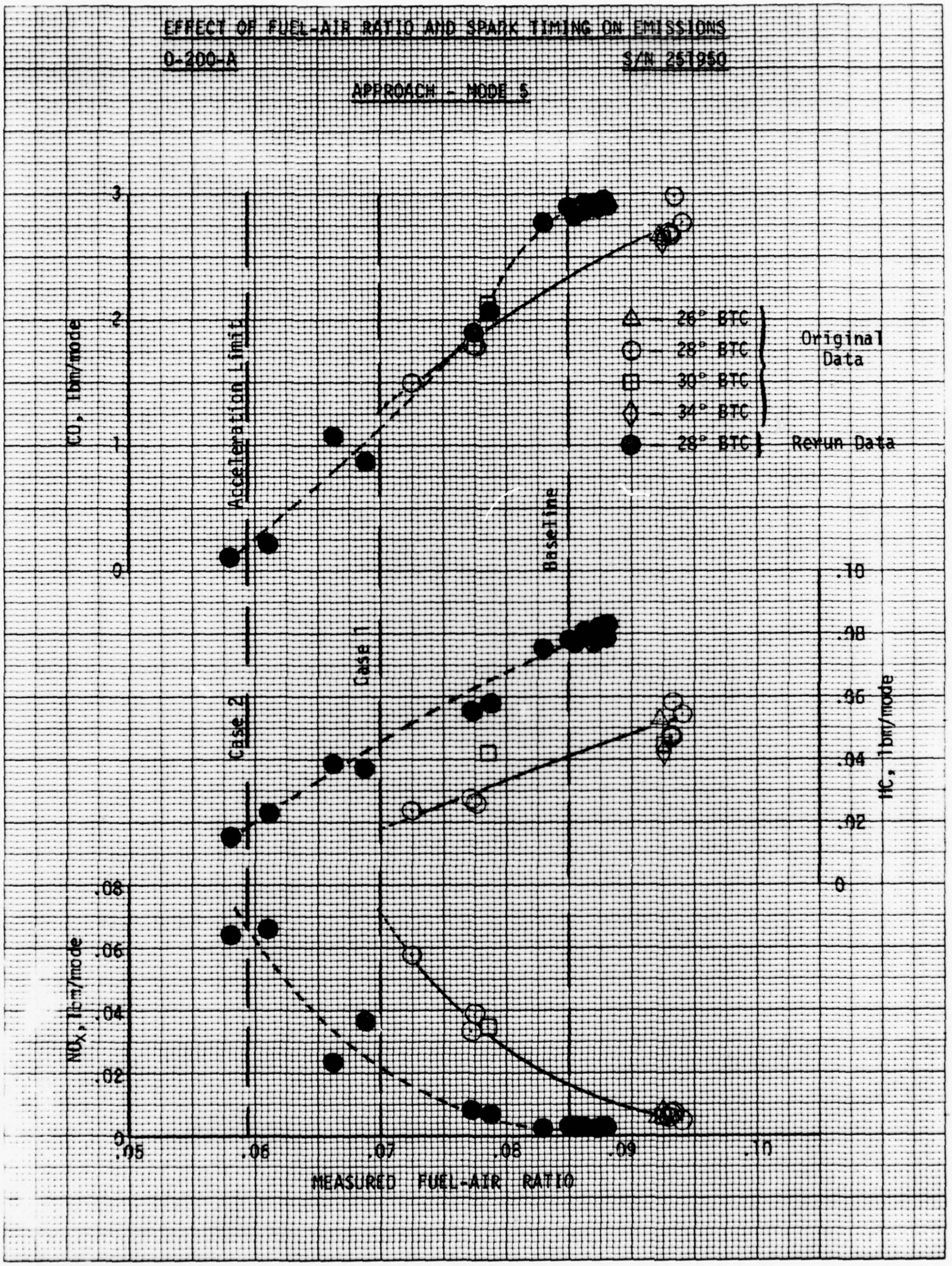

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
O-200-A
S/N 251950
APPROACH - MODE 5
CO, lbm/mode
HC, lbm/mode
NO$_X$, lbm/mode
MEASURED FUEL-AIR RATIO
Acceleration Limit
Case 2
Case 1
Baseline
26° BTC
28° BTC
30° BTC
34° BTC
Original Data
28° BTC
Rerun Data
.05
.06
.07
.08
.09
.10

FIGURE 4.1-6

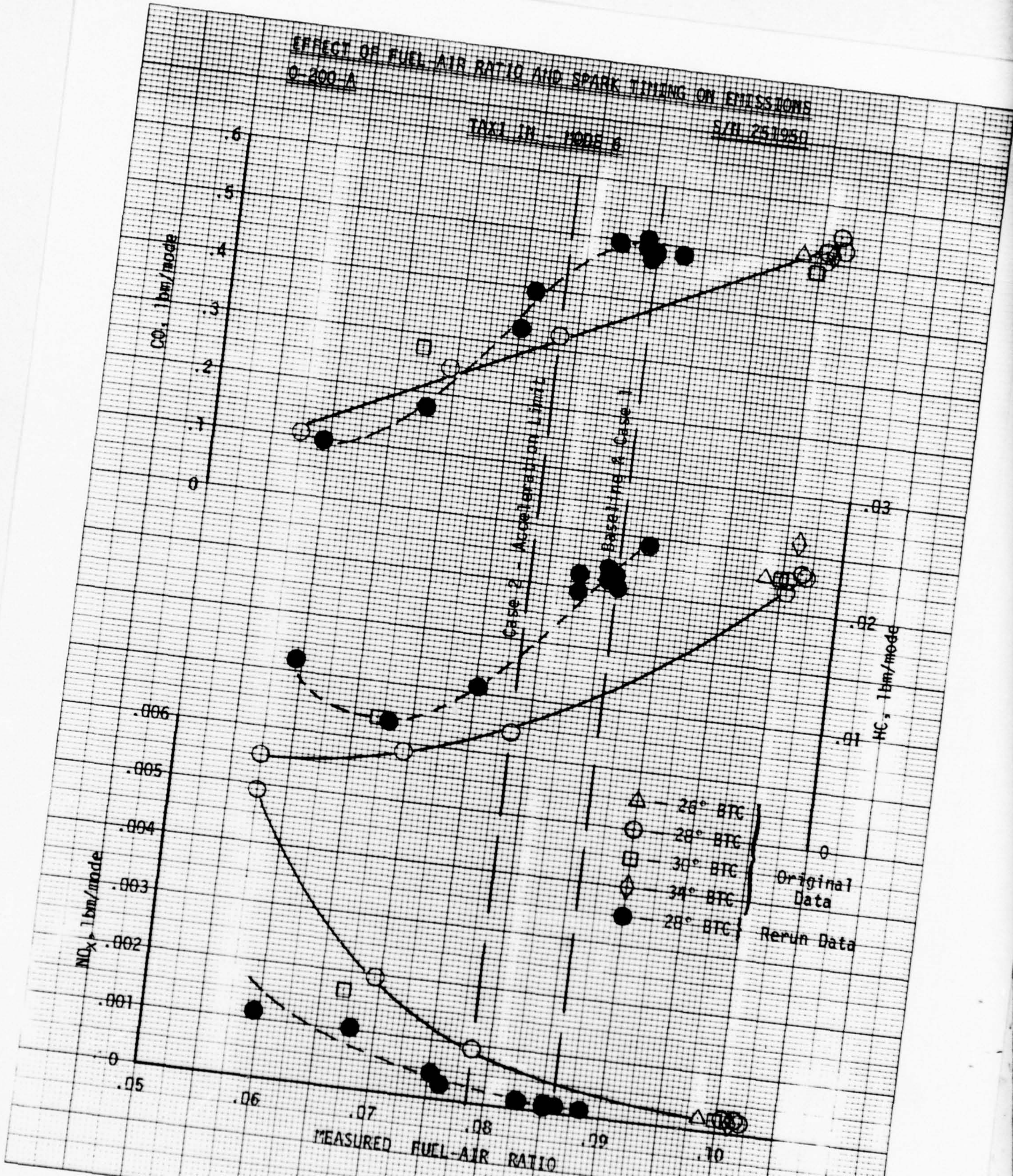
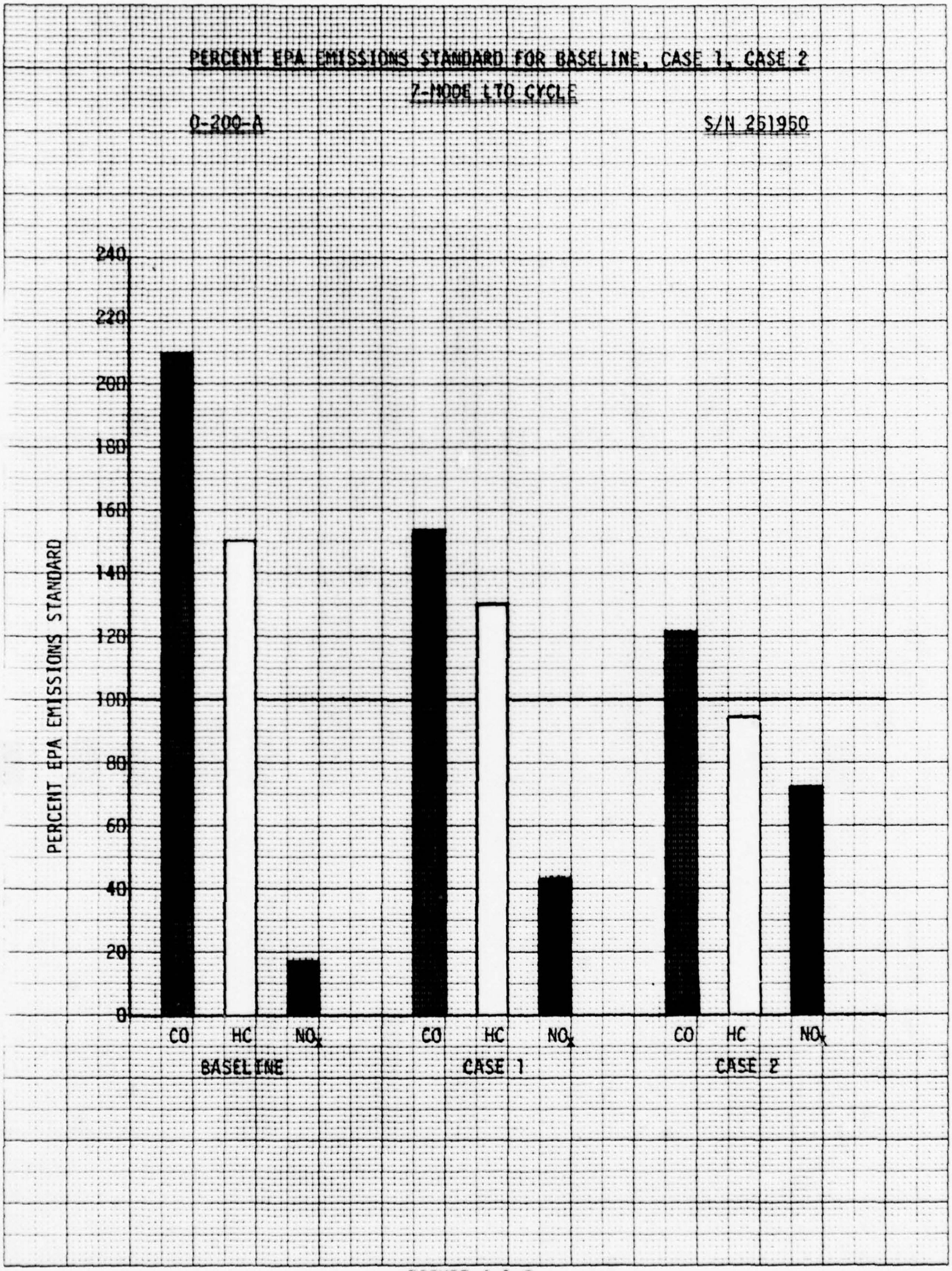
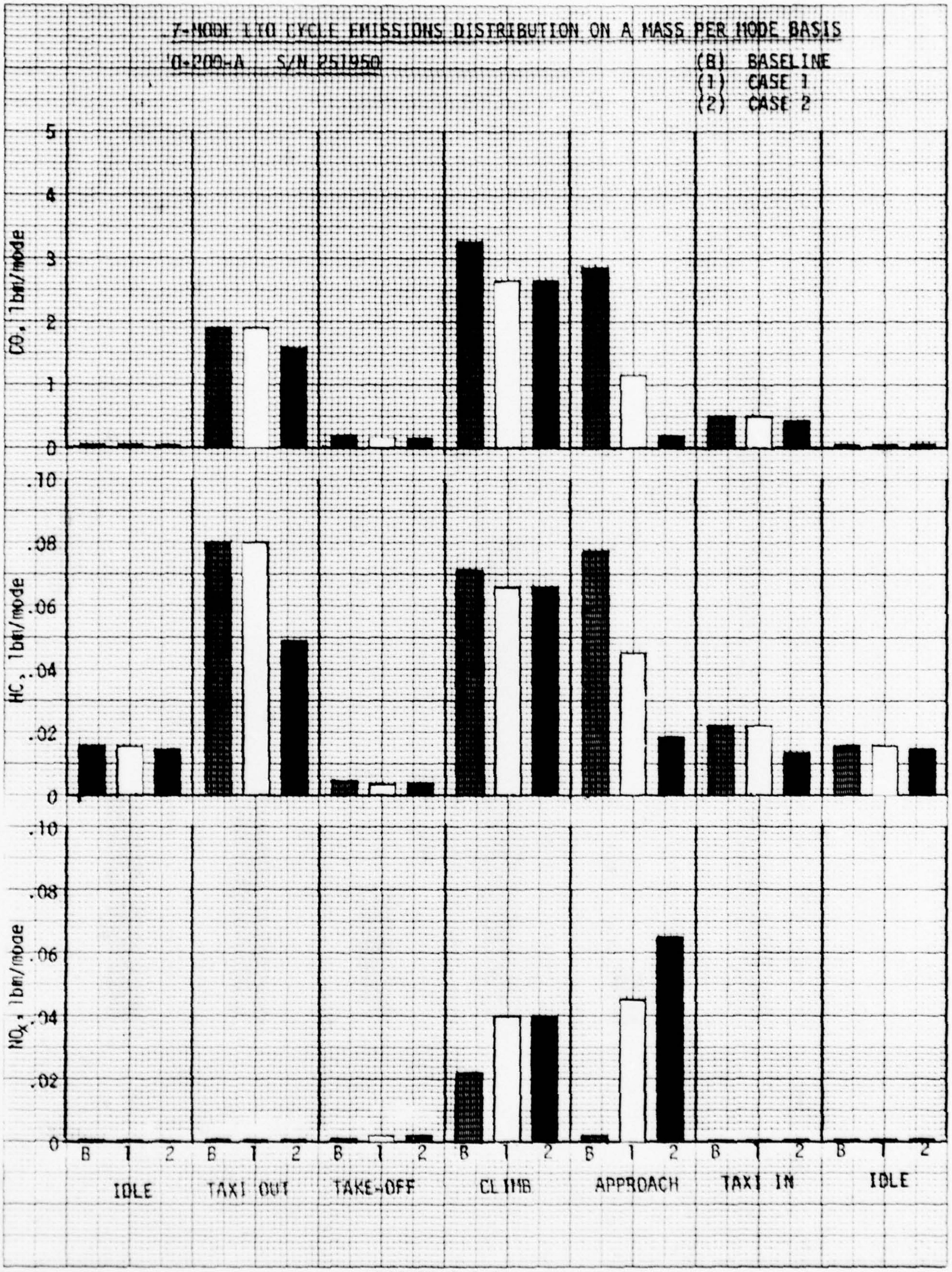

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
O-200-A
TAXI IN - MODE 6
S/N 251950
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
Case 2 - Acceleration Limit
Baseline & Case 1
26° BTC
28° BTC
30° BTC
34° BTC
Original Data
28° BTC
Rerun Data
MEASURED FUEL-AIR RATIO

FIGURE 4.1-7



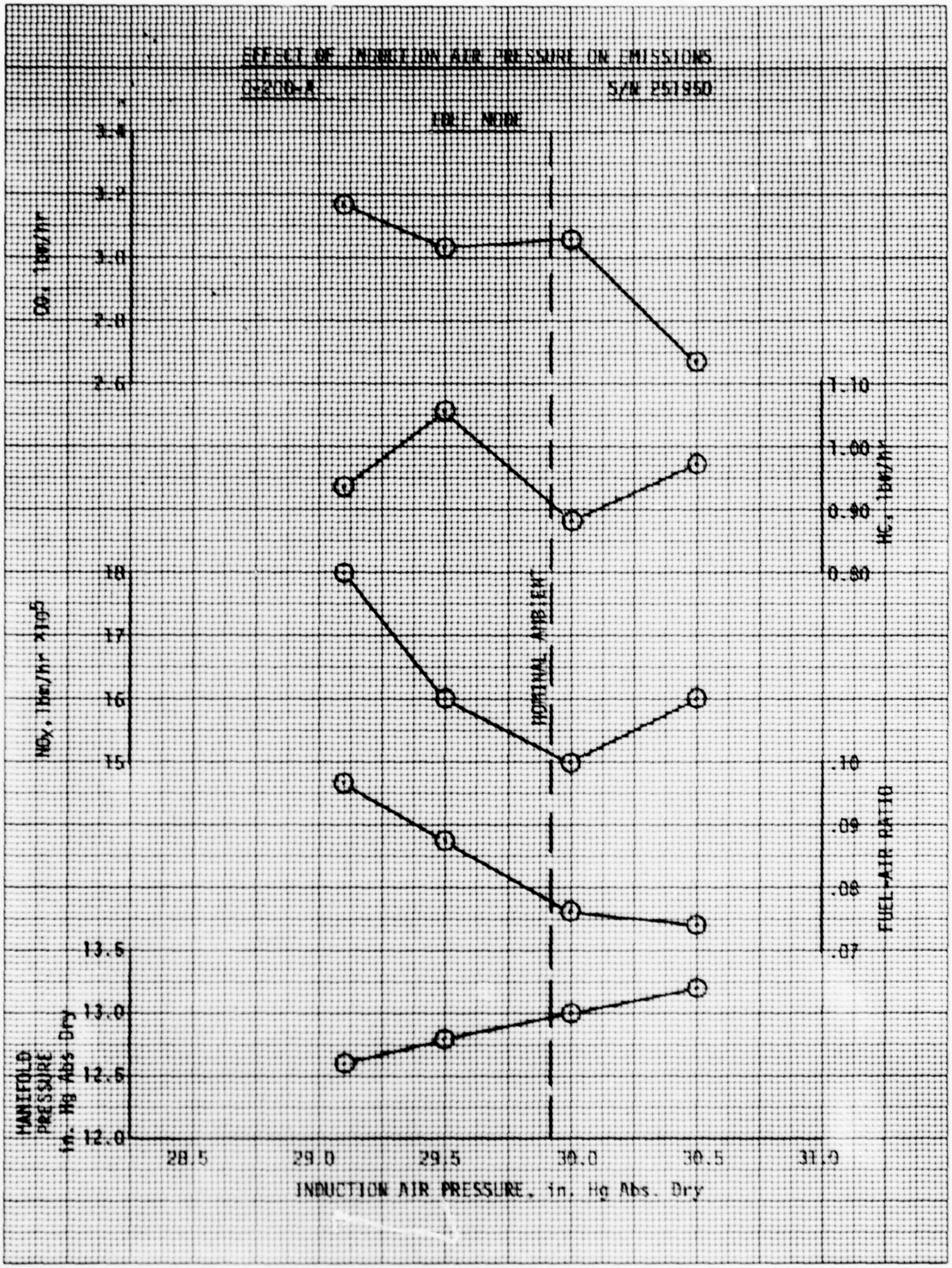
PERCENT EPA EMISSIONS STANDARD FOR BASELINE, CASE 1, CASE 2
7-MODE LTO CYCLE
0-200-A
S/N 261950
PERCENT EPA EMISSIONS STANDARD
240
220
200
180
160
140
120
100
80
60
40
20
0
CO
HC
NO_x
BASELINE
CO
HC
NO_x
CASE 1
CO
HC
NO_x
CASE 2

FIGURE 4.1-8



7-MODE LTO CYCLE EMISSIONS DISTRIBUTION ON A MASS PER MODE BASIS
O-200-A S/N 251950
(B) BASELINE
(1) CASE 1
(2) CASE 2
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
B 1 2
IDLE
TAXI OUT
TAKE-OFF
CLIMB
APPROACH
TAXI IN
IDLE

FIGURE 4.1-9



EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
O-200-A
S/N 251950
IDLE MODE
CO, lbm/hr
3.4
3.2
3.0
2.8
2.6
HC, lbm/hr
1.10
1.00
0.90
0.80
NOx, lbm/hr x10-5
18
17
16
15
FUEL-AIR RATIO
.10
.09
.08
.07
NOMINAL AMBIENT
MANIFOLD PRESSURE in. Hg Abs Dry
13.5
13.0
12.5
12.0
28.5
29.0
29.5
30.0
30.5
31.0
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.1-10

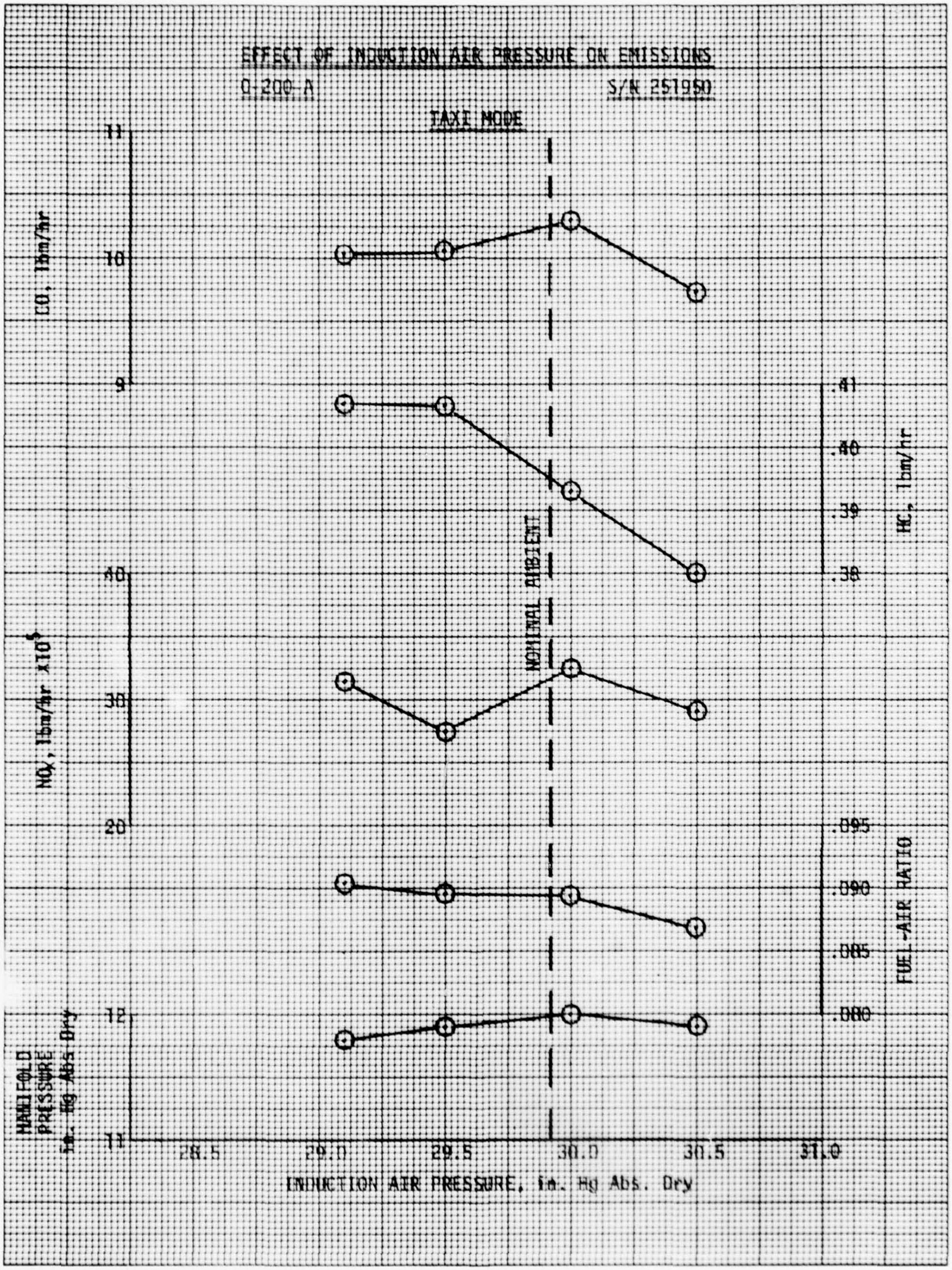
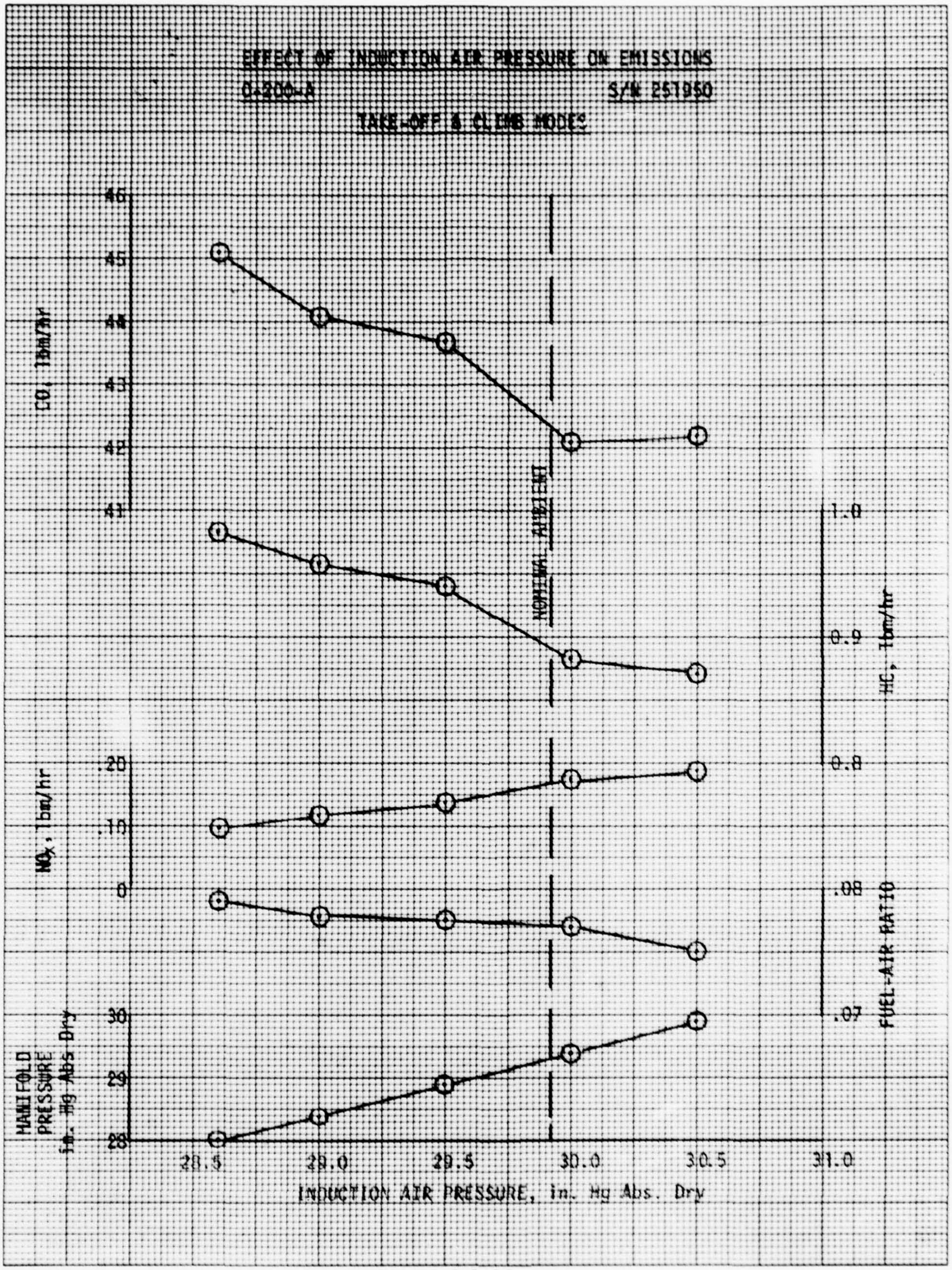
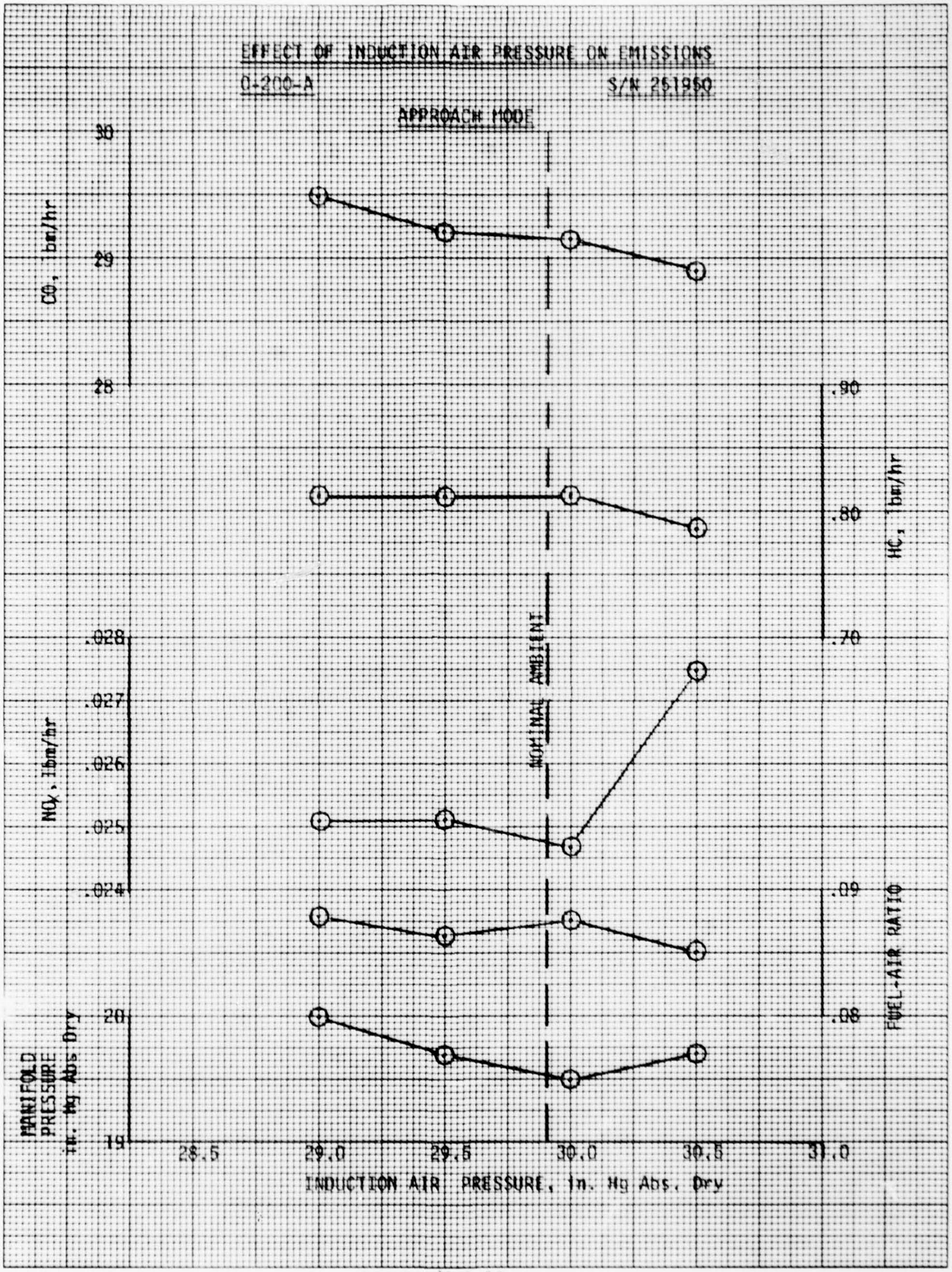

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
O-200-A
S/N 251950
TAXI MODE
CO, lbm/hr
NOx, lbm/hr x10³
MANIFOLD PRESSURE in. Hg Abs Dry
HC, lbm/hr
FUEL-AIR RATIO
NOMINAL AMBIENT
INDUCTION AIR PRESSURE, in. Hg Abs. Dry
28.5
29.0
29.5
30.0
30.5
31.0
11
10
9
40
30
20
12
11
.41
.40
.39
.38
.095
.090
.085
.080

FIGURE 4.1-11



EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
O-200-A
S/N 251950
TAKE-OFF & CLIMB MODES
CO, lbm/hr
46
45
44
43
42
41
NOMINAL AMBIENT
1.0
0.9
0.8
HC, lbm/hr
NO_x, lbm/hr
.20
.10
0
.08
.07
FUEL-AIR RATIO
MANIFOLD PRESSURE in. Hg Abs Dry
30
29
28
28.5
29.0
29.5
30.0
30.5
31.0
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.1-12



EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
O-200-A
S/N 251950
APPROACH MODE
CO, lbm/hr
30
29
28
HC, lbm/hr
.90
.80
.70
NOMINAL AMBIENT
NOx, lbm/hr
.028
.027
.026
.025
.024
FUEL-AIR RATIO
.09
.08
MANIFOLD PRESSURE in. Hg Abs Dry
20
19
28.5
29.0
29.5
30.0
30.5
31.0
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.1-13

4.2 IO-520-D Exhaust Emissions Test Results

The IO-520 series engines represent about one-third of TCM's current production of aircraft piston engines. The D model was chosen as being representative of the naturally aspirated 520 series due to its versatile use in both the transportation and agricultural areas of General Aviation.

The IO-520-D engine has a TCM continuous flow fuel injection system which responds to variations in throttle angle and engine speed.

The Type Certificate recommended fuel flow specification is shown in Figure 4.2-1 where BASELINE fuel flows are shown as the average of the rich and lean limit full rich fuel flows. CASE 1 fuel flows are at the lean limit above 75% power, and at the minimum allowable fuel flow below 75% power.

Figures 4.2-2 thru 4.2-7 show the effect of lean operation and spark timing variation on emissions of CO, HC and NO_x for each mode. The solid circle data points represent data taken after the completion of the flight tests (see also Section 5). A problem with induction air flow measurement was encountered after the post-flight test emissions tests were completed. The discrepancy in measured air flow is apparent in the curves for retest "D" and retest "L" solid circle data points in Figures 4.2-2 thru 4.2-7. Once the data was taken, there was no way to correct it mathematically as the magnitude and cause of the air flow errors were unknown. It is, however, known that all the air flows were too high. For the lower power modes of Idle and Taxi, the air flows seem to be high by about 10 - 15%. In the higher power modes of Takeoff, Climb and Approach the air flows are suspected to be too high by about 2 - 5%.

There was no significant benefit in emissions levels achieved for the 7-Mode LTO Cycle due to magneto timing variations.

The 7-Mode LTO Cycle emissions are presented in Figure 4.2-8. BASELINE operation of this engine exceeds the EPA Standards for both CO and HC. The Standards for all three pollutants are met, however, for CASE 1 and CASE 2 fuel flow schedules.

The distribution of the three pollutants among the seven modes is illustrated in Figure 4.2-9. The main contributors to CO emissions are the Climb and Approach modes. Hydrocarbons are formed mainly in the Taxi Out mode, and NO_x, primarily in the Climb and Approach modes. This engine shows the one exception to the general trend of CASE 2 being leaner than CASE 1. In the Approach mode data of Figure 4.2-9 it can be seen that CASE 1 is leaner than CASE 2 (the CO and HC are lower and the NO_x higher for CASE 1). Figure 4.2-6 shows this more clearly. The engine reached its estimated acceleration limit (CASE 2) before the leanest allowable fuel flow limit (CASE 1). In normal aircraft operation this would not be considered a problem because acceleration is recommended only from the full rich mixture position. Also, flight tests confirmed acceptable acceleration from CASE 2 (see Section 5).

Of all five engines tested, the IO-520-D has the longest running time history. The engine was initially run at TCM on January 14, 1975. Upon completion of testing in April of 1975, the engine was shipped to the Federal Aviation Administration's National Aviation Facilities Experimental Center (NAFEC) in Atlantic City, New Jersey for confirmation testing. The engine was then

returned to TCM and installed in the flight test aircraft where tests were conducted in Mobile, Alabama, Fargo, North Dakota, Del Rio and Laredo, Texas and Eglin AFB Climatic Laboratory in Florida. During this period the engine had accumulated over 300 hours of operating time. Upon completion of the flight test, additional emissions data were taken. Although the engine was found to be within acceptable limits on oil consumption and cylinder compression, the measured hydrocarbon values were found to be about double in the Takeoff and Climb modes from when the engine was first tested. The hydrocarbons levels were slightly higher than the original Taxi and Idle and Approach modes.

A top overhaul was performed (new cylinder head assemblies plus new pistons and piston rings) and the engine was again checked for emissions. The hydrocarbon values had returned to their original levels.

Figure 4.2-10 shows the results of the overhaul on the 7-Mode LTO Cycle emissions. The data used in 4.2-10 was derived from individual tests rather than composite data as presented in Figure 4.2-8.

During the course of the testing on this engine the hydrocarbon emissions had increased by about 42% over the entire cycle. Subsequent inspection of the cylinder barrels showed an abnormal condition of cylinder barrel glazing. The glaze, caused by the accumulation of baked oil deposits on the barrel, prevented the piston rings from wearing-in to conform with the cylinder bore. While oil consumption was within normal specifications, it was sufficiently higher to promote the increased HC readings.

Cylinder barrel measurements were made to confirm that the bore was within serviceable limits. In fact, three of the cylinders appeared to be still within production new limits. Figure 4.2-11 shows graphically the result of these measurements. The depicted cylinder bore "choke" (decrease in diameter toward top of cylinder) is built into the cylinder to account for the outward combustion pressure and thermal expansion of the cylinder when the engine is running.

The reason for the cylinder barrel glazing occurring on this engine is thought to be due to the abnormal running conditions the engine experienced during the early part of its normal break-in interval. During initial emissions testing the engine was operated for long periods of time at idle and low power settings for the purpose of gathering emissions data. These long periods of low power running may have contributed to the eventual glazing of the cylinder barrels. The effect of cylinder barrel glazing on the flight test results (installed safety limits) are considered negligible.

Another contribution to increased oil consumption for this engine was intake valve guide wear, also thought to be caused by the abnormal running schedule to which this engine was subjected. During the intake stroke at low manifold pressures, oil was flowing down the worn intake valve guide from the rocker arm cover area. This problem was corrected when the new cylinder head assemblies were installed.

TABLE 4.2-1

IO-520-D ENGINE DESCRIPTION

TYPE CERTIFICATE NUMBER	E5CE
DATE OF ISSUANCE	8/30/65
NUMBER OF CYLINDERS	6
CUBIC INCH DISPLACEMENT	519.54
CYLINDER BORE (inches)	5.25
PISTON STROKE (inches)	4.00
COMPRESSION RATIO	8.5:1
DRIVE RATIO (propeller/crankshaft)	1:1
AIR INDUCTION SYSTEM	NATURALLY ASPIRATED
FUEL CONTROL SYSTEM	FUEL INJECTED
RATED MAXIMUM TAKE-OFF POWER	300 BHP
RATED MAXIMUM TAKE-OFF PROPELLER RPM	2850 RPM
RATED MAXIMUM CONTINUOUS POWER	285 BHP
RATED MAXIMUM CONTINUOUS PROPELLER RPM	2700 RPM
MAXIMUM ALLOWABLE CYLINDER HEAD TEMPERATURE	460^{o}F
MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE	--
MINIMUM FUEL OCTANE RATING	100/130 Avgas
IGNITION TIMING (degrees btc)	22^{o}

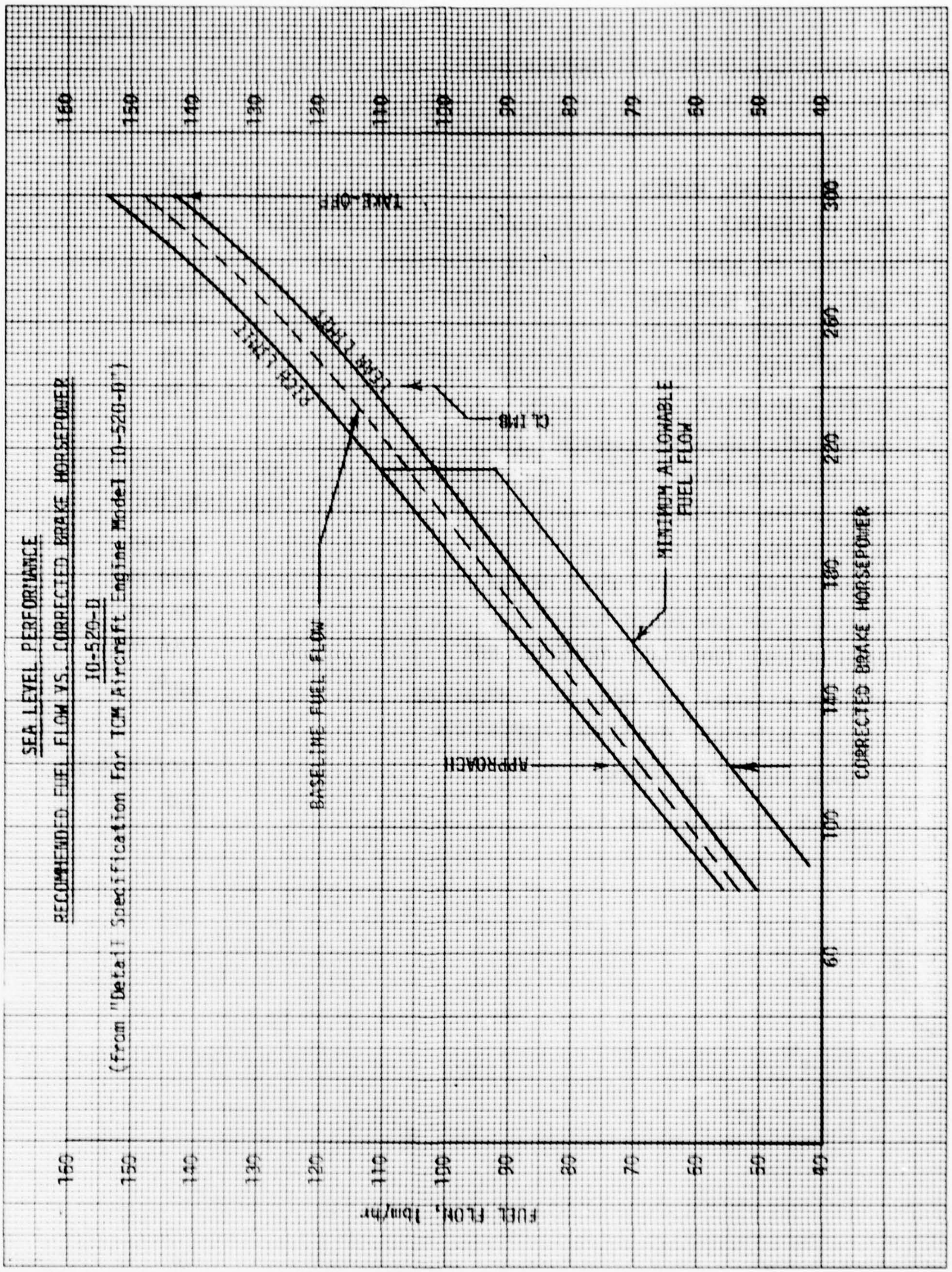
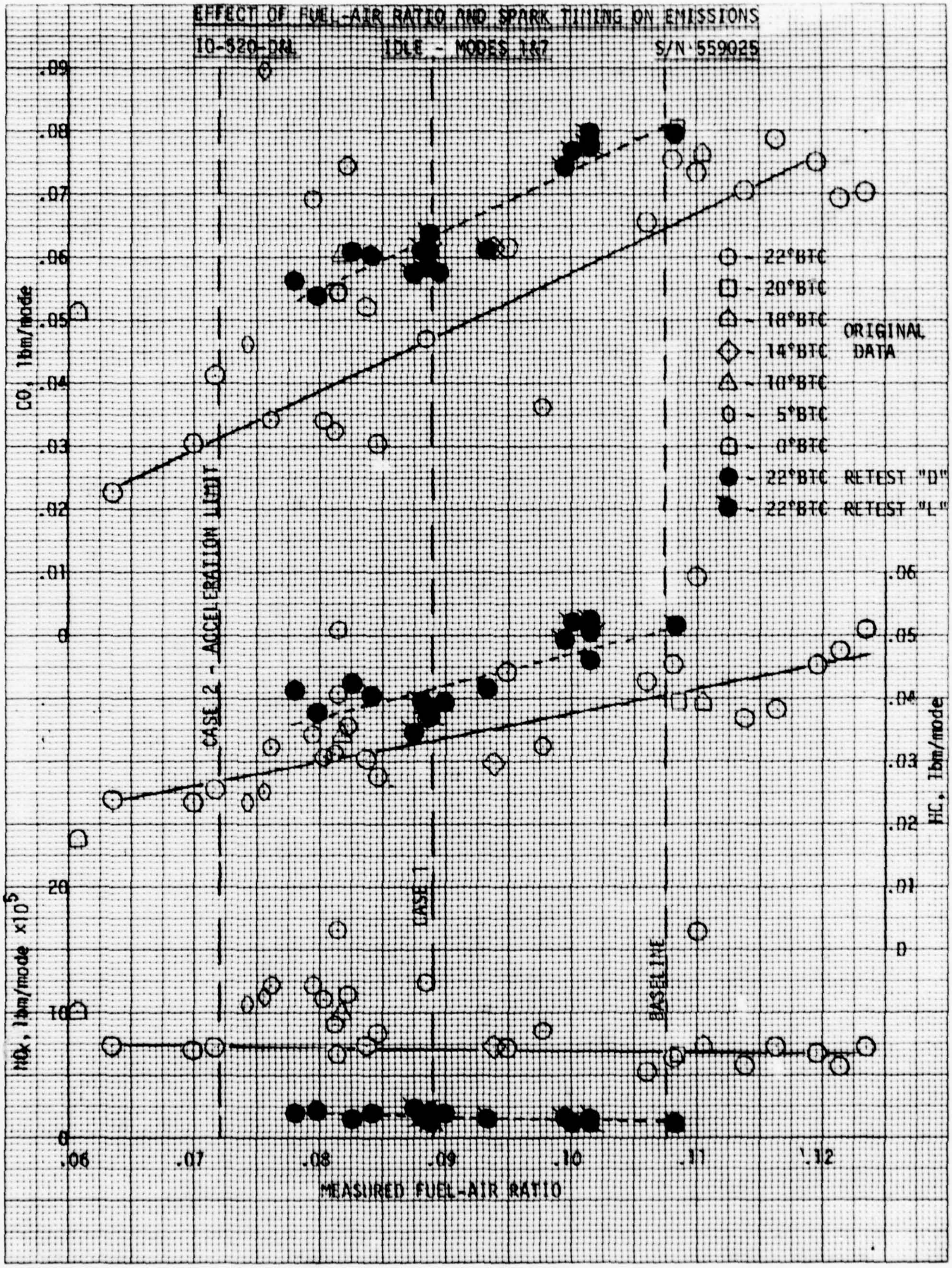
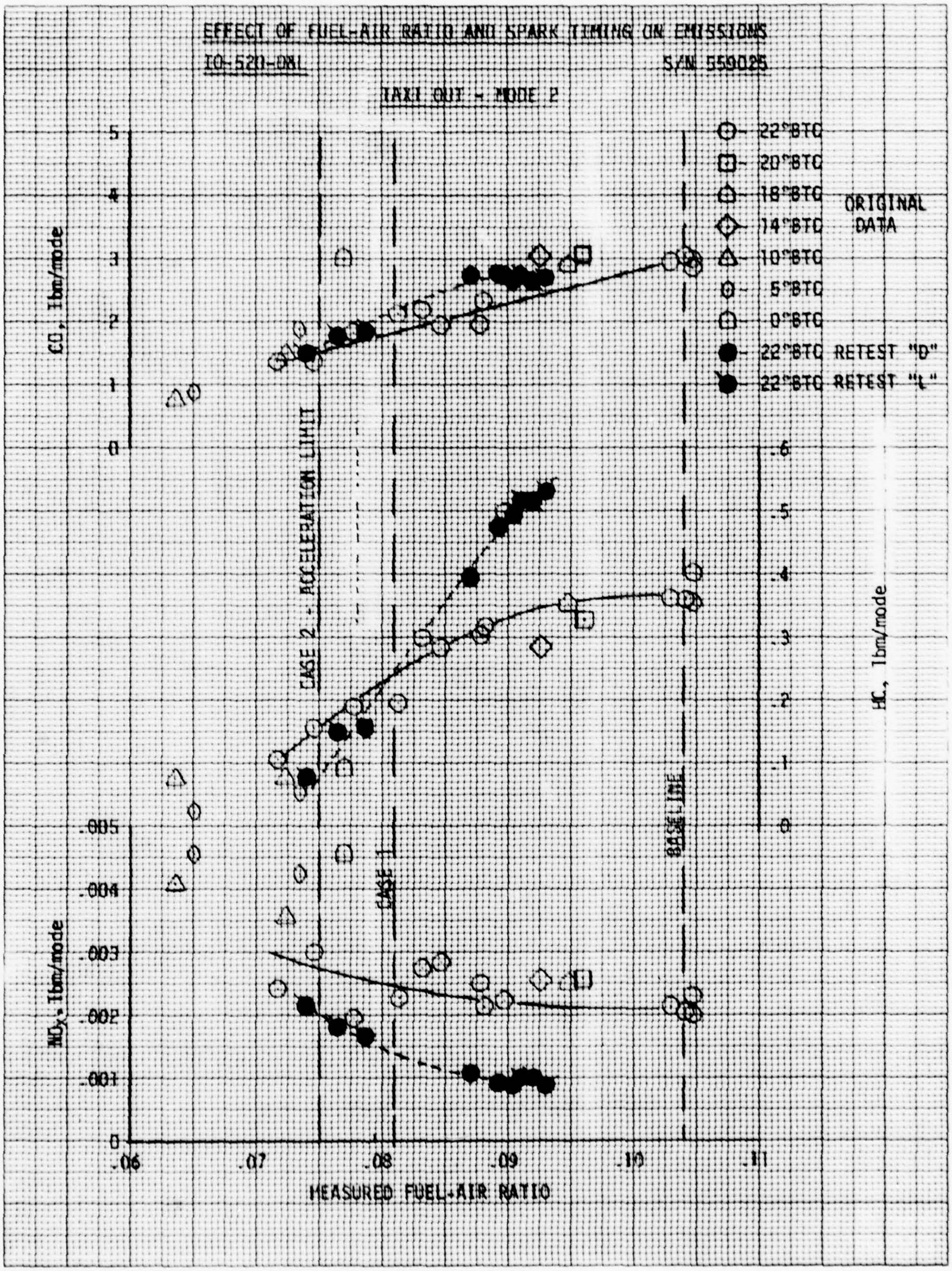

SEA LEVEL PERFORMANCE
RECOMMENDED FUEL FLOW VS. CORRECTED BRAKE HORSEPOWER
IO-520-D
(From "Detail Specification for TCM Aircraft Engine Model IO-520-D")
TAKE OFF
CLIMB
MINIMUM ALLOWABLE FUEL FLOW
BASELINE FUEL FLOW
APPROACH
CORRECTED BRAKE HORSEPOWER
FUEL FLOW, lbm/hr

FIGURE 4.2-1



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IO-520-DRL
IDLE - MODES 1&7
S/N 559025
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode x10^5
MEASURED FUEL-AIR RATIO
CASE 2 - ACCELERATION LIMIT
CASE 1
BASELINE
- 22°BTC
- 20°BTC
- 18°BTC
- 14°BTC
- 10°BTC
- 5°BTC
- 0°BTC
ORIGINAL DATA
- 22°BTC RETEST "D"
- 22°BTC RETEST "L"

FIGURE 4.2-2



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IO-520-D8L
S/N 559025
TAXI OUT - MODE 2
22°BTC
20°BTC
18°BTC
14°BTC
10°BTC
5°BTC
0°BTC
ORIGINAL DATA
22°BTC RETEST "D"
22°BTC RETEST "L"
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
CASE 2 - ACCELERATION LIMIT
CASE 1
BASELINE
MEASURED FUEL-AIR RATIO

FIGURE 4.2-3

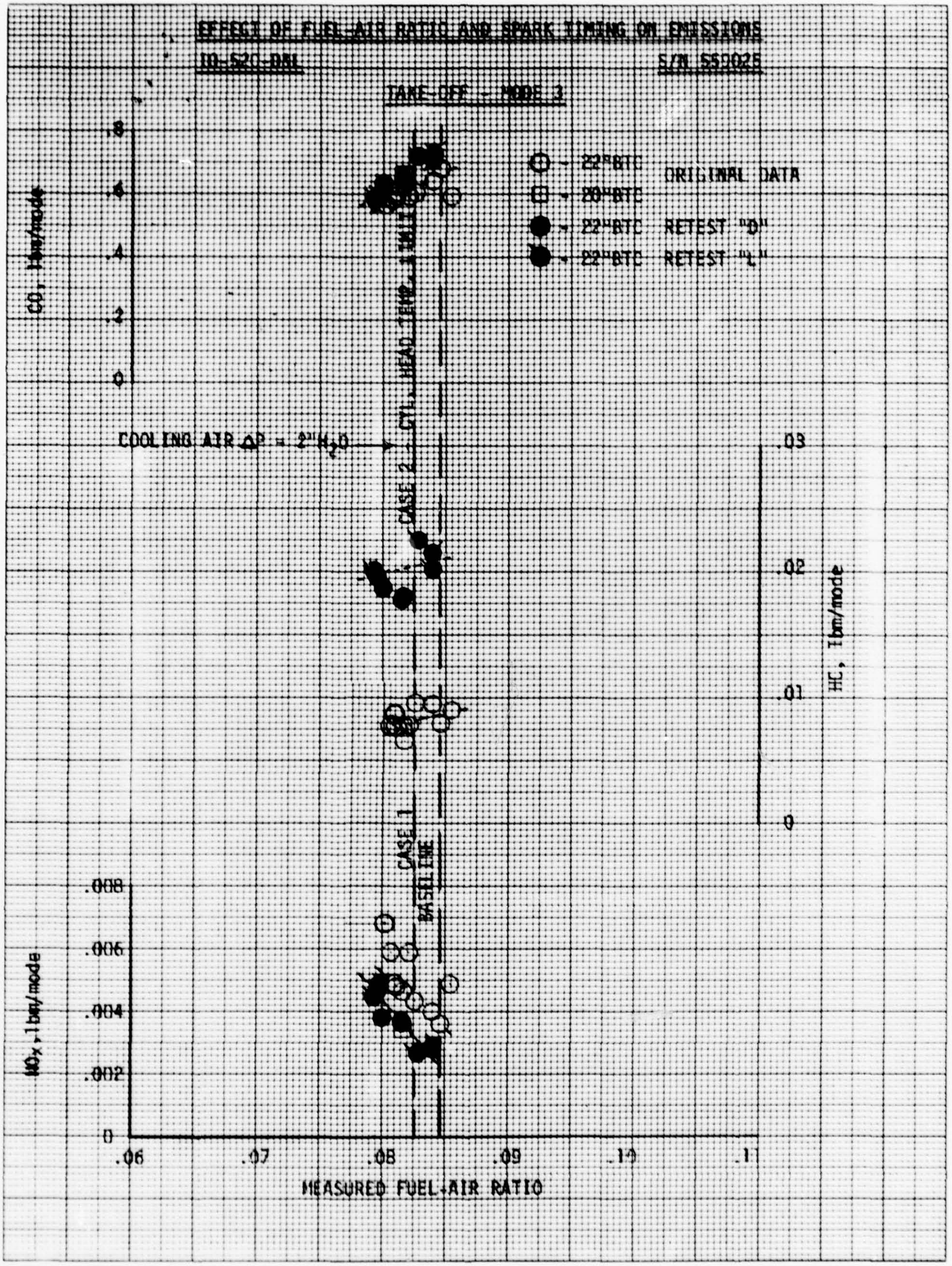

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IO-520-DAL
S/N 559025
TAKE-OFF - MODE 3
22°BTC
20°BTC
ORIGINAL DATA
22°BTC RETEST "D"
22°BTC RETEST "L"
CO, lbm/mode
COOLING AIR ΔP = 2" H2O
CASE 2 - CYL. HEAD TEMP. LIMIT
CASE 1
BASELINE
HC, lbm/mode
NOx, lbm/mode
MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10
.11

FIGURE 4.2-4

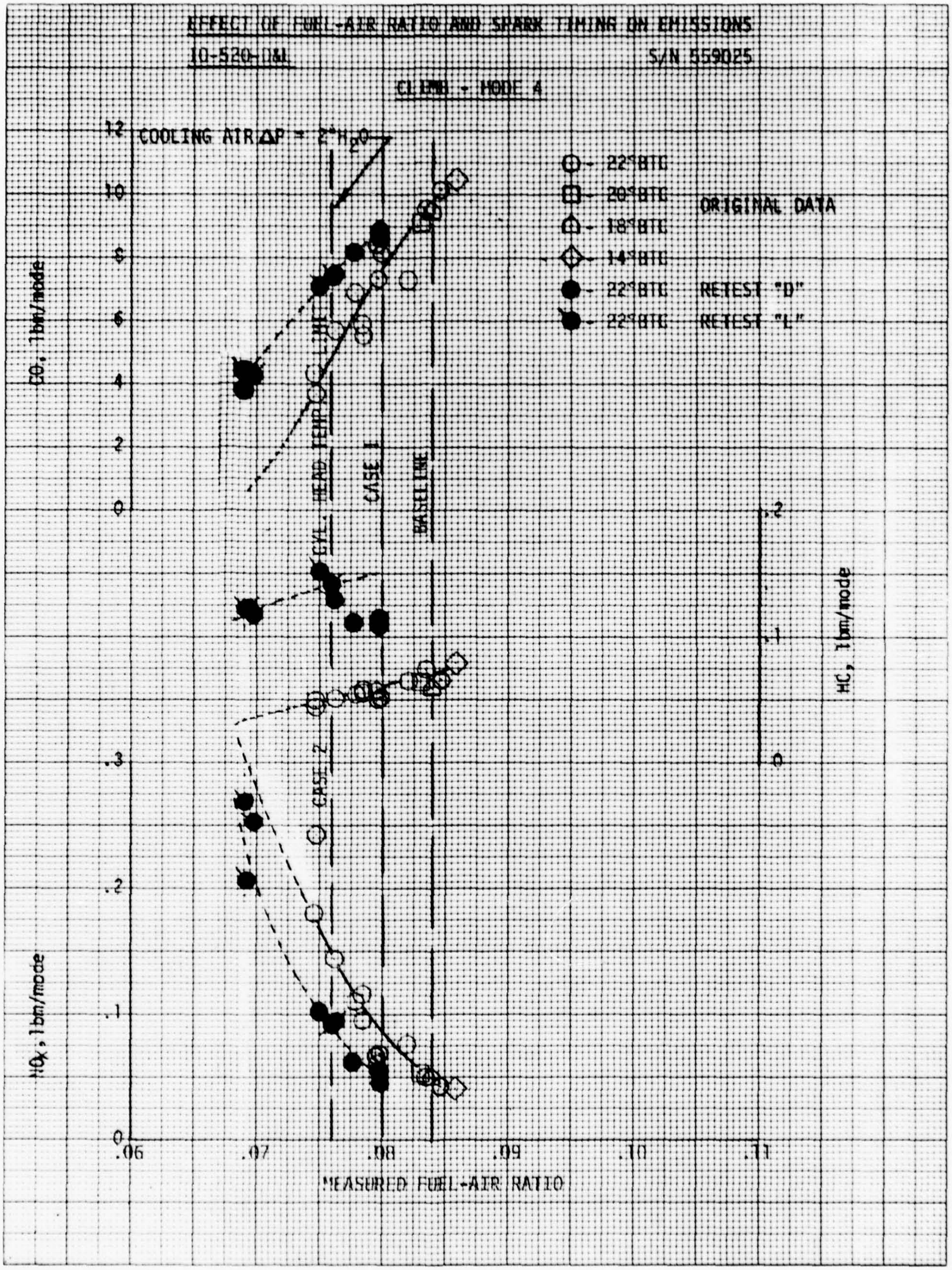
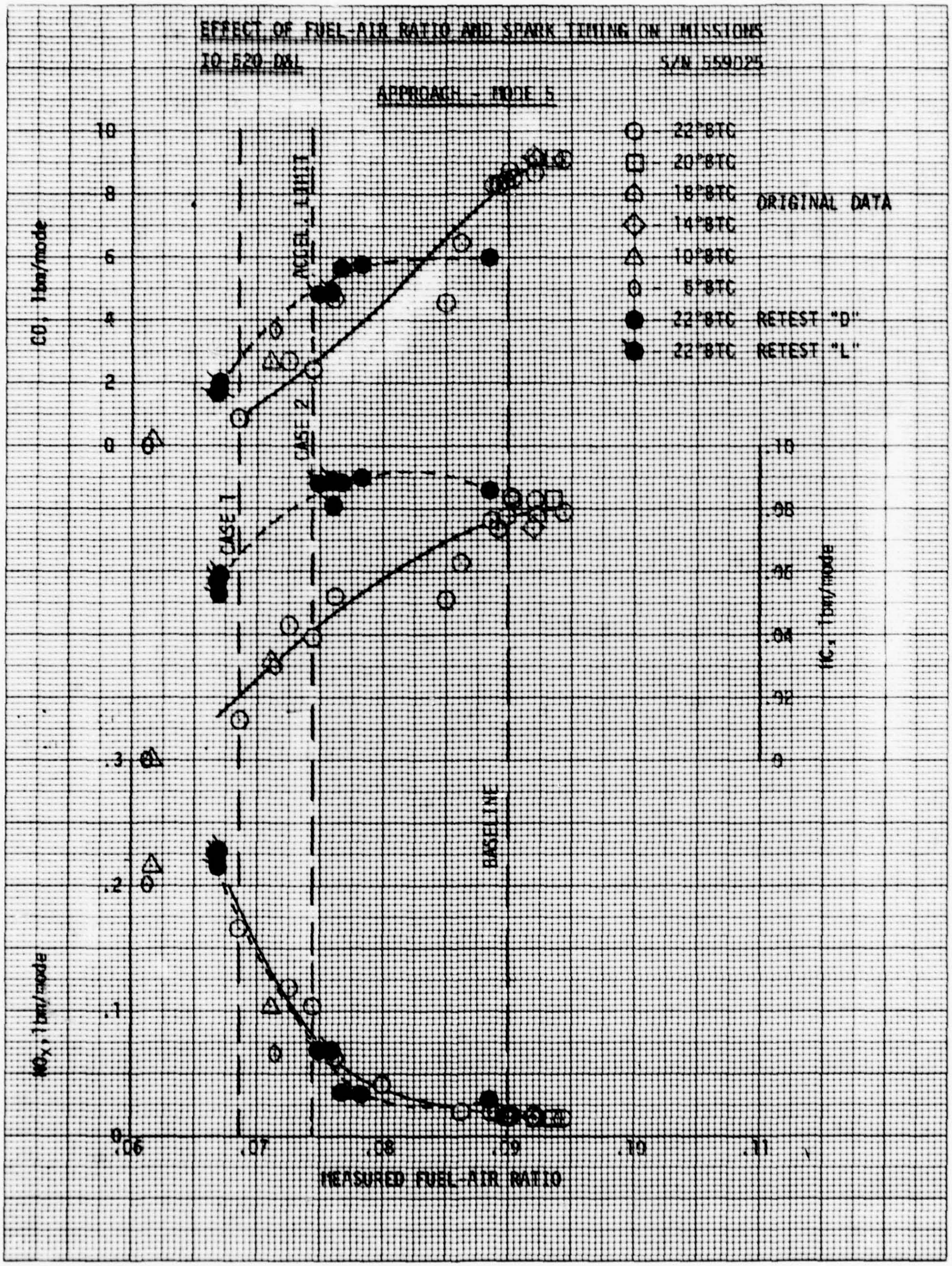

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IO-520-D&L
S/N 559025
CLIMB - MODE 4
COOLING AIR ΔP = 2"H2O
22°BTC
20°BTC
18°BTC
14°BTC
ORIGINAL DATA
22°BTC RETEST "D"
22°BTC RETEST "L"
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
CYL. HEAD TEMP LIMIT
CASE 1
CASE 2
BASELINE
MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10
.11

FIGURE 4.2-5



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IO-520-D&L
S/N 559025
APPROACH - MODE 5
22°BTC
20°BTC
18°BTC
14°BTC
10°BTC
6°BTC
ORIGINAL DATA
22°BTC RETEST "D"
22°BTC RETEST "L"
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
CASE 1
CASE 2
ACCEL. LIMIT
BASELINE
MEASURED FUEL-AIR RATIO

FIGURE 4.2-6

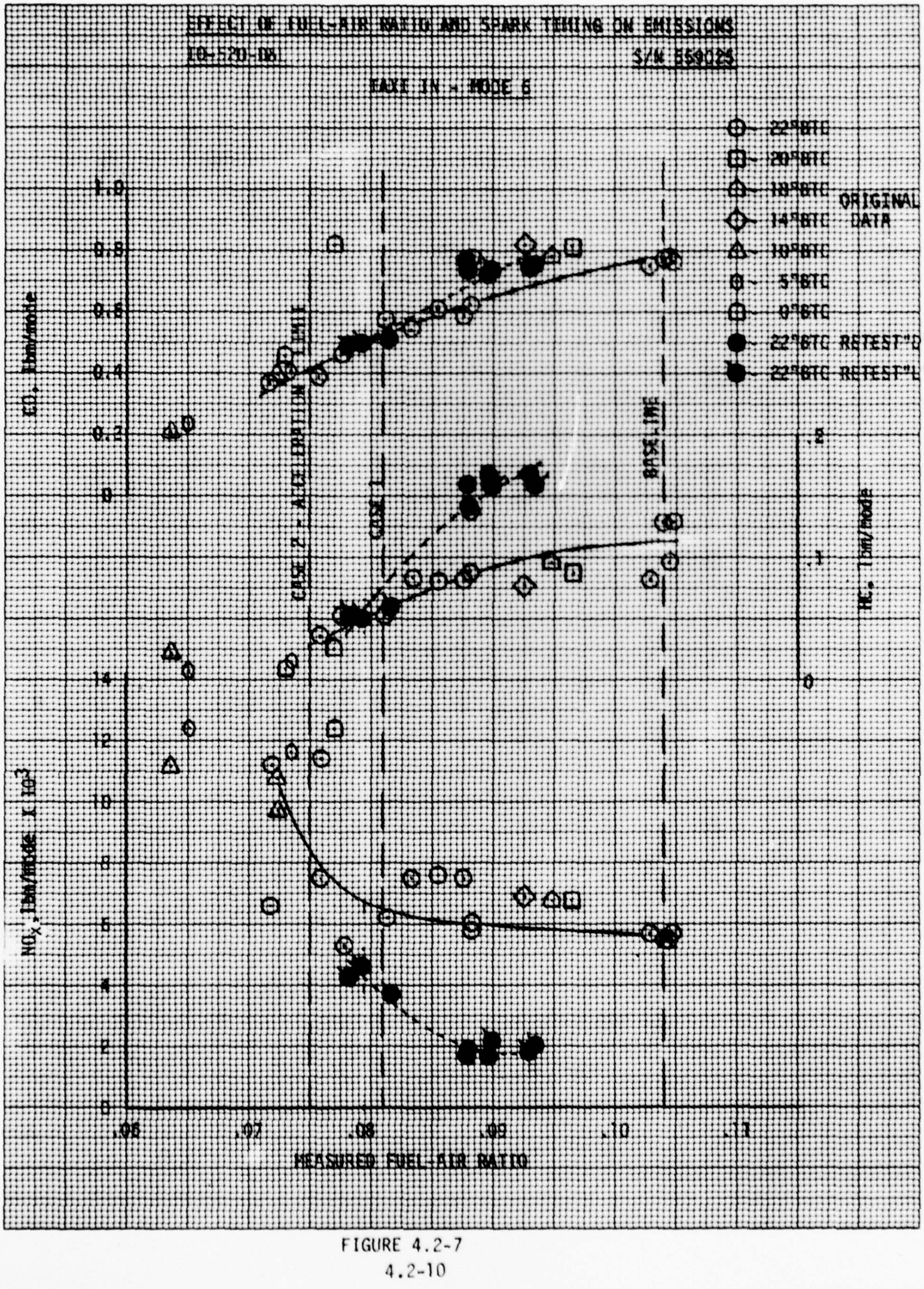

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IO-520-D8
S/N 559025
TAXI IN - MODE 6
22°BTC
20°BTC
18°BTC
14°BTC
10°BTC
5°BTC
0°BTC
ORIGINAL DATA
22°BTC RETEST"D"
22°BTC RETEST"L"
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode X 10³
CASE 2 - ACCELERATION LIMIT
CASE 1
BASELINE
MEASURED FUEL-AIR RATIO

FIGURE 4.2-7

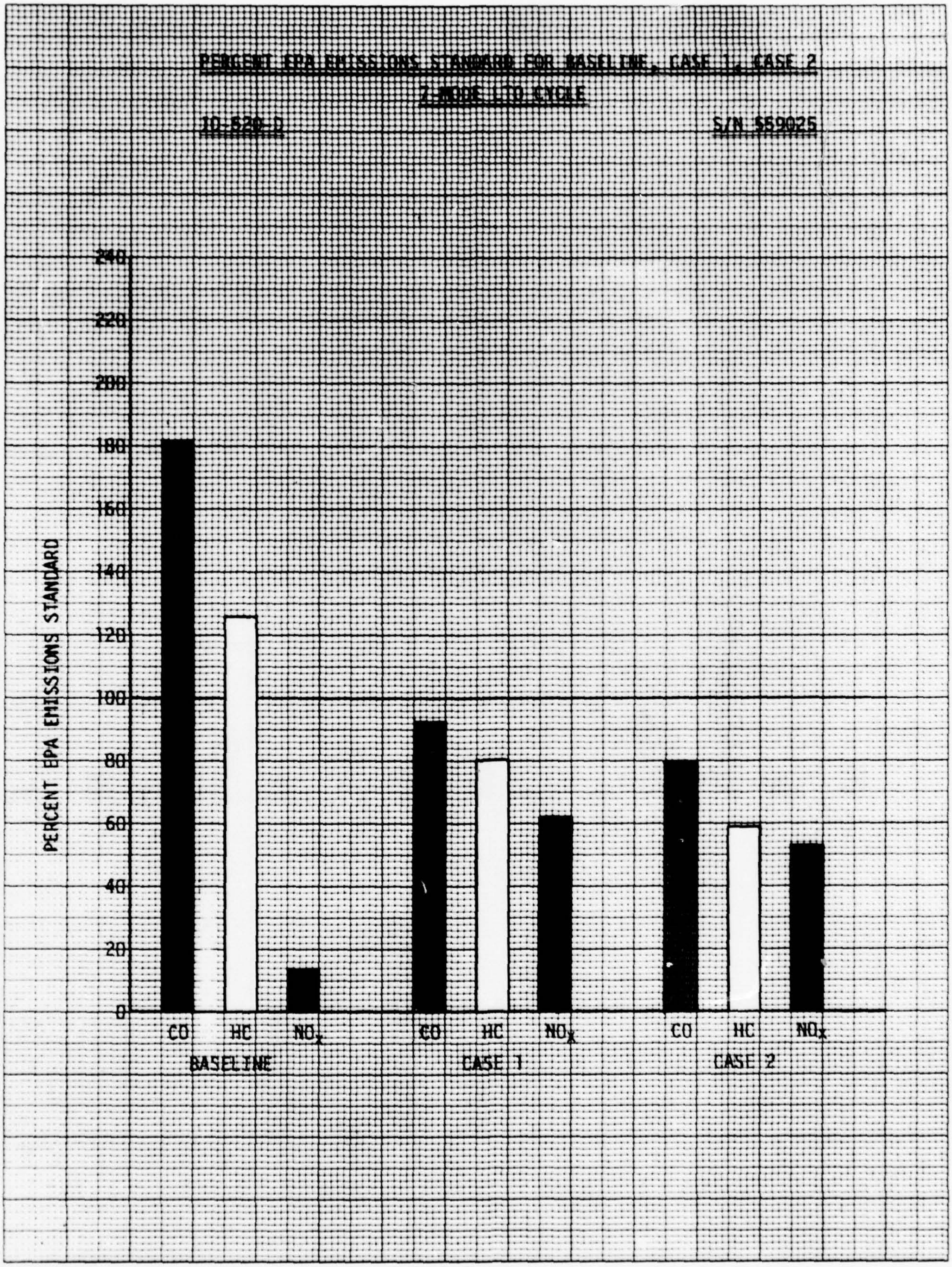

PERCENT EPA EMISSIONS STANDARD FOR BASELINE, CASE 1, CASE 2
7-MODE LTO CYCLE
IO-520-D
S/N 559025
PERCENT EPA EMISSIONS STANDARD
240
220
200
180
160
140
120
100
80
60
40
20
0
CO
HC
NO_x
CO
HC
NO_x
CO
HC
NO_x
BASELINE
CASE 1
CASE 2

FIGURE 4.2-8

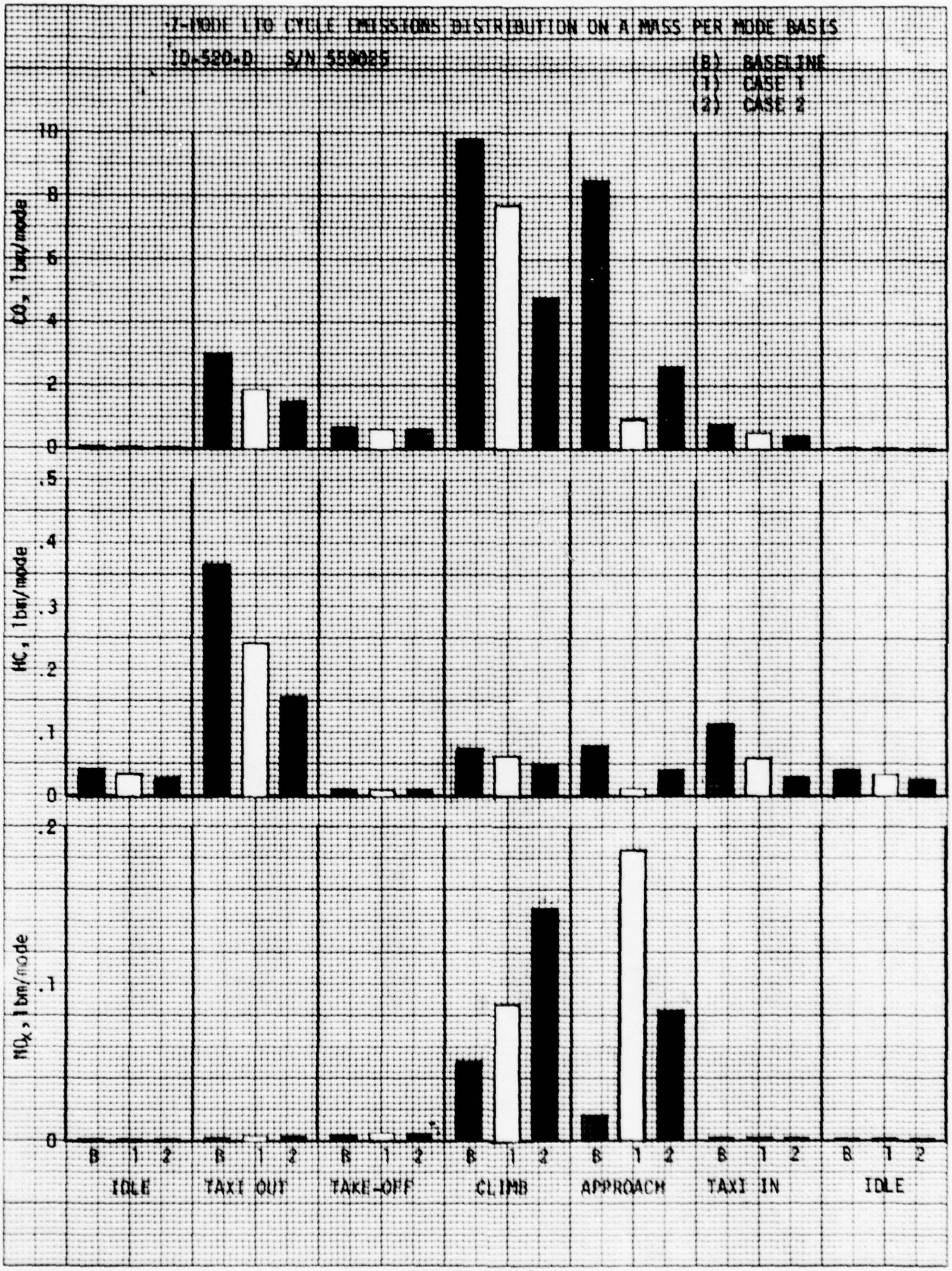

7-MODE LTO CYCLE EMISSIONS DISTRIBUTION ON A MASS PER MODE BASIS
JT8D-17 S/N 559025
(B) BASELINE
(1) CASE 1
(2) CASE 2
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
B 1 2
IDLE
TAXI OUT
TAKE-OFF
CLIMB
APPROACH
TAXI IN
IDLE

FIGURE 4.2-9

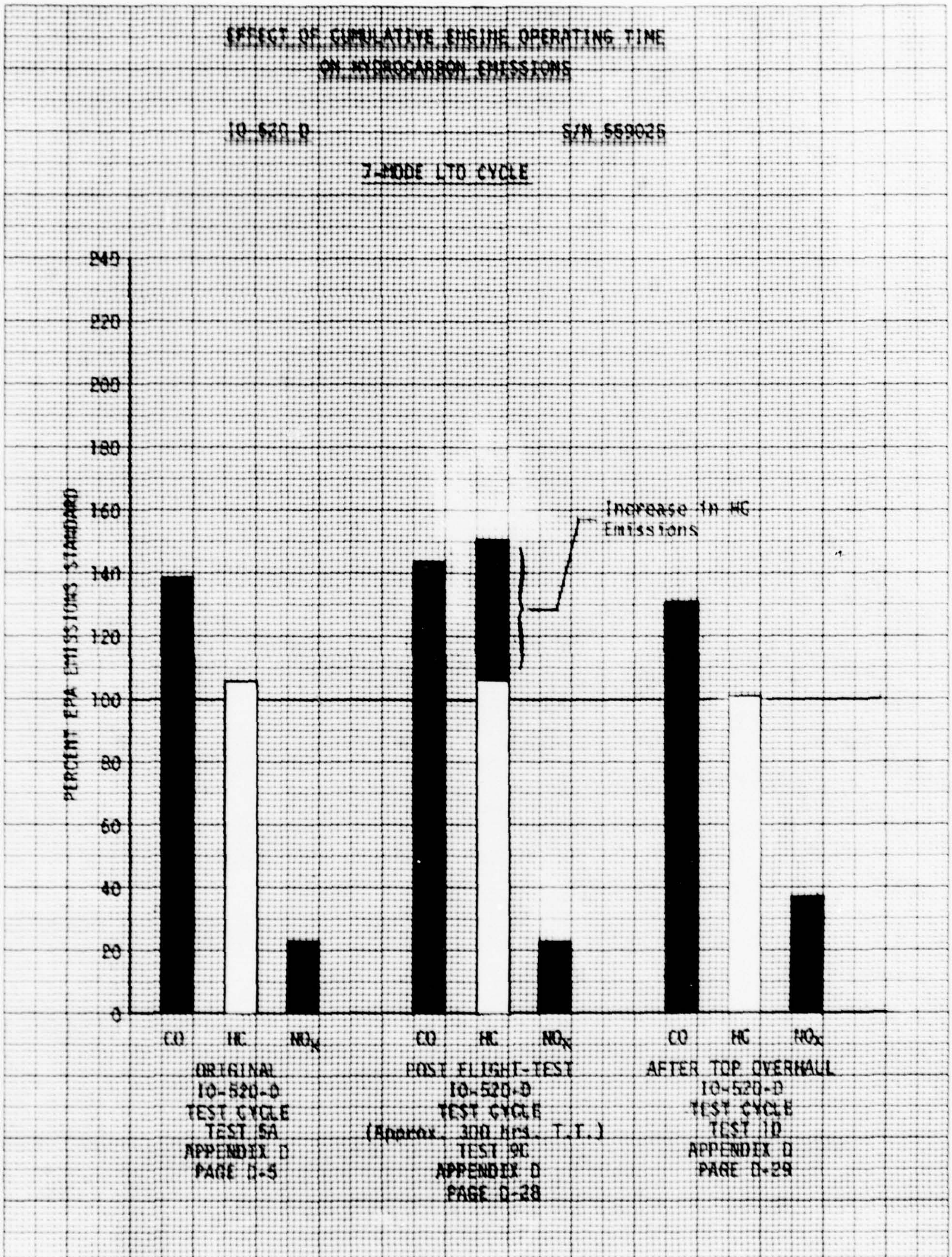

EFFECT OF CUMULATIVE ENGINE OPERATING TIME
ON HYDROCARBON EMISSIONS
IO-520-D
S/N 569025
7-MODE LTO CYCLE
PERCENT EPA EMISSIONS STANDARD
240
220
200
180
160
140
120
100
80
60
40
20
0
Increase in HC Emissions
CO
HC
NOx
ORIGINAL
IO-520-D
TEST CYCLE
TEST 5A
APPENDIX D
PAGE D-5
POST FLIGHT-TEST
IO-520-D
TEST CYCLE
(Approx. 300 Hrs. T.T.)
TEST 9C
APPENDIX D
PAGE D-28
AFTER TOP OVERHAUL
IO-520-D
TEST CYCLE
TEST 1D
APPENDIX D
PAGE D-29

FIGURE 4.2-10

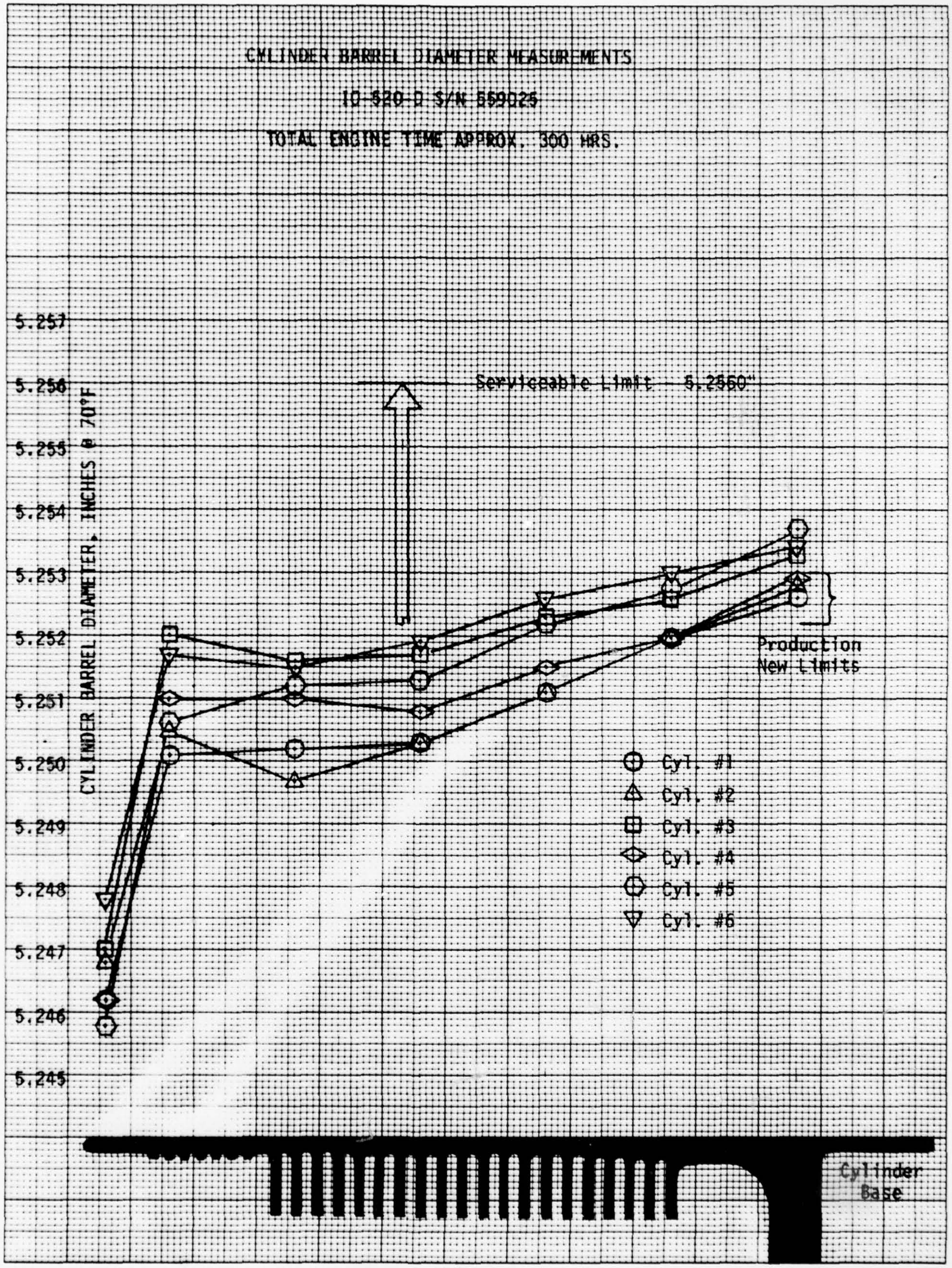

CYLINDER BARREL DIAMETER MEASUREMENTS
IO-520-D S/N 559025
TOTAL ENGINE TIME APPROX. 300 HRS.
Serviceable Limit - 5.2560"
Production New Limits
Cyl. #1
Cyl. #2
Cyl. #3
Cyl. #4
Cyl. #5
Cyl. #6
CYLINDER BARREL DIAMETER, INCHES @ 70°F
5.257
5.256
5.255
5.254
5.253
5.252
5.251
5.250
5.249
5.248
5.247
5.246
5.245
Cylinder Base

FIGURE 4.2-11

4.3 TSIO-360-C Exhaust Emissions Test Results

The TSIO-360-C is representative of a class of engines increasing in popularity for the rapidly expanding light twin-engine aircraft market. The TSIO-360-C has provisions for a turbocharger compressor sonic venturi air bleed for cabin pressurization and uses a TCM continuous flow fuel injection system responding to throttle angle, engine speed and turbocharger compressor discharge pressure.

The Type Certificate recommended fuel flow schedule is presented in Figure 4.3-1 where BASELINE fuel flows are the average of the rich and lean limits of full rich fuel flow. CASE 1 fuel flows are at the lean limit above 75% power and at the minimum allowable fuel flow below 75% power. The curve shows enrichment of fuel flow above 75% power for lower cylinder head temperatures during high power operation (see also Figure 3-2).

Figures 4.3-2 thru 4.3-7 show the effect of fuel-air ratio and spark timing on emissions for each of the individual operating modes of the 7-Mode LTO Cycle. No significant exhaust emissions reductions were observed by variation of the magneto timing.

The exhaust emissions for BASELINE, CASE 1 and CASE 2 as a percent of the EPA Standards are presented in Figure 4.3-8. The exhaust emissions for this engine are characterized by high hydrocarbons when compared to the other four test engines and compared to its carbon monoxide level. The disbribution of emissions, by mode, throughout the cycle (Figure 4.3-9) show that these hydrocarbon emissions are produced predominantly in the Taxi Out Mode.

Carbon monoxide and nitric oxide production are mainly contributed to by the Climb and Approach Modes.

The effect of induction air pressure variations on exhaust emissions, shown in Figures 4.3-10 through 4.3-14, seems to follow the fuel-air ratio variations during the Take-Off, Climb and Approach Modes. Increasing the induction air pressure, decreases the fuel-air ratio with a resulting decrease in HC and CO. The Idle and Taxi Modes display a more complex behavior in response to pressure variations due to the propeller governor being inoperative at these low speeds. An increase in induction air pressure would cause higher engine RPM, and closing the throttle further to maintain the defined Taxi and Idle RPM settings would cause a decrease in fuel flow. This results in an increasing fuel-air ratio with increasing induction air pressure, for the Idle Mode as shown in Figure 4.3-10.

A survey of emissions variations with RPM was conducted on this engine. The results (Figure 4.3-15) show the normal variation of fuel-air ratio with increasing engine speed from 600 to 1600 RPM. Carbon monoxide and nitric oxide mass flow rates increase with engine speed (increasing power) as expected, while hydrocarbon mass flow rates decrease due to higher exhaust gas temperatures, higher combustion turbulence and improved homogeneity of the fuel-air charge.

Figure 4.3-15 presents the results of variations in RPM and manifold pressure at constant power. The Climb Mode power setting used throughout the previous emissions investigations per the Contract requirements was 80% power 90% RPM. The propeller governor, however, allows operation at any RPM between 2390 and 2800 RPM at constant 80% power by adjusting the throttle to provide a corresponding manifold pressure. The increase in RPM, increases fuel flow, while the decrease in manifold pressure (reduced throttle angle) decreases fuel flow. The net result is a decrease in fuel flow while air flow will increase slightly as the throttle is opened at lower speeds. As a result, emissions of HC, CO and NO_x respond accordingly to the reduction in fuel-air ratio at constant power as the speed is increased. HC and CO mass emissions are lowered while NO_x increases.

TABLE 4.3-1

TSIO-360-C ENGINE DESCRIPTION

TYPE CERTIFICATE NUMBER	E9CE
DATE OF ISSUANCE	1/19/72
NUMBER OF CYLINDERS	6
CUBIC INCH DISPLACEMENT	359.66
CYLINDER BORE (inches)	4.438
PISTON STROKE (inches)	3.875
COMPRESSION RATIO	7.5:1
DRIVE RATIO (propeller/crankshaft)	1:1
AIR INDUCTION SYSTEM	TURBOCHARGED
FUEL CONTROL SYSTEM	FUEL INJECTED
RATED MAXIMUM TAKE-OFF POWER	225 BHP
RATED MAXIMUM TAKE-OFF PROPELLER RPM	2800 RPM
RATED MAXIMUM CONTINUOUS POWER	225 BHP
RATED MAXIMUM CONTINUOUS PROPELLER RPM	2800 RPM
MAXIMUM ALLOWABLE CYLINDER HEAD TEMPERATURE	460^{o}F
MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE	1650^{o}F
MINIMUM FUEL OCTANE RATING	100/130 Avgas
IGNITION TIMING (degrees btc)	20^{o}

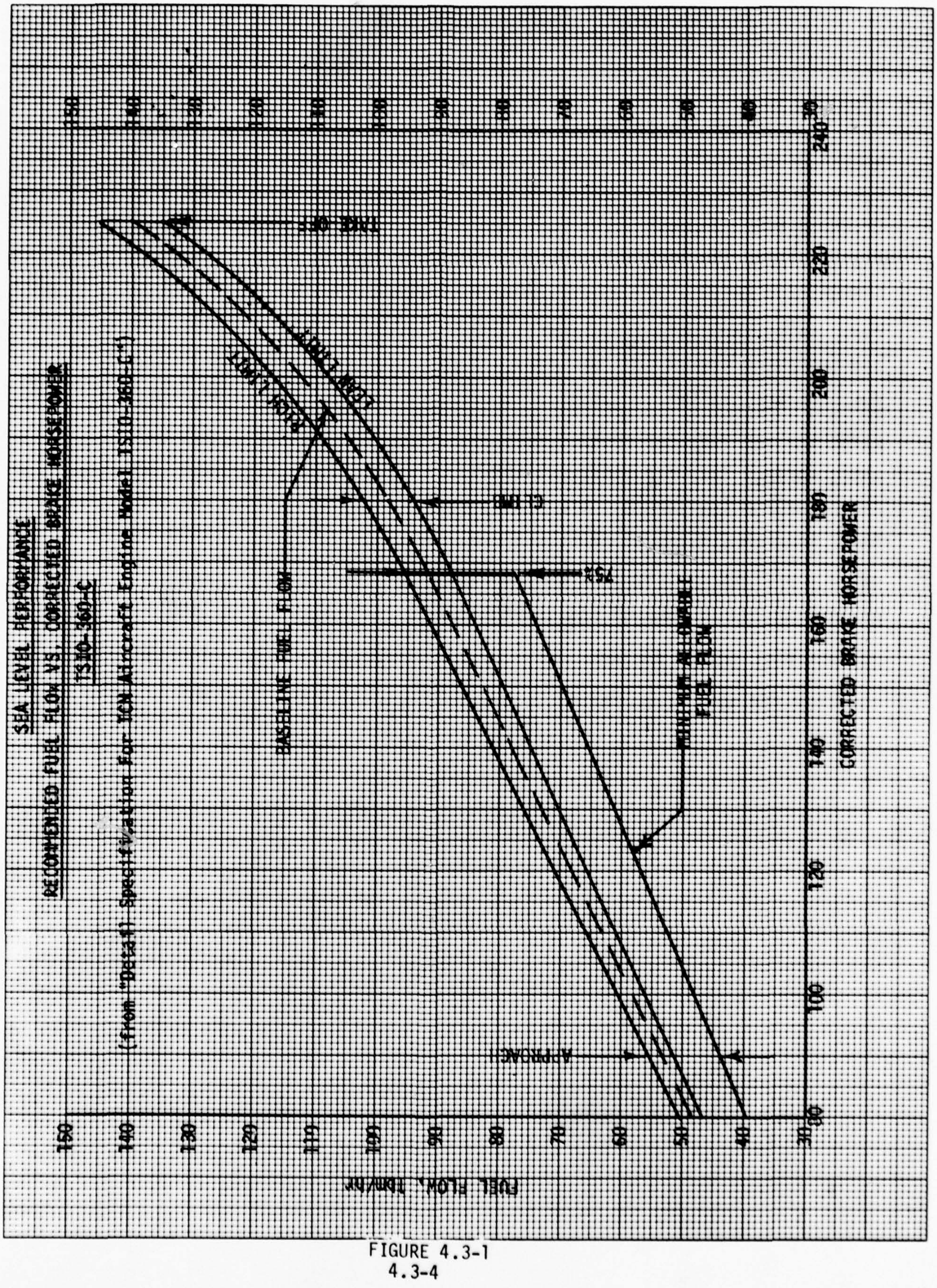

SEA LEVEL PERFORMANCE
RECOMMENDED FUEL FLOW VS. CORRECTED BRAKE HORSEPOWER
TSIO-360-C
(From "Detail" Specification for TCM Aircraft Engine Model TSIO-360-C*)
TAKE-OFF
UPPER LIMIT
LOWER LIMIT
CLIMB
75%
BASELINE FUEL FLOW
MINIMUM ALLOWABLE FUEL FLOW
APPROACH
FUEL FLOW, lbm/hr
CORRECTED BRAKE HORSEPOWER

FIGURE 4.3-1

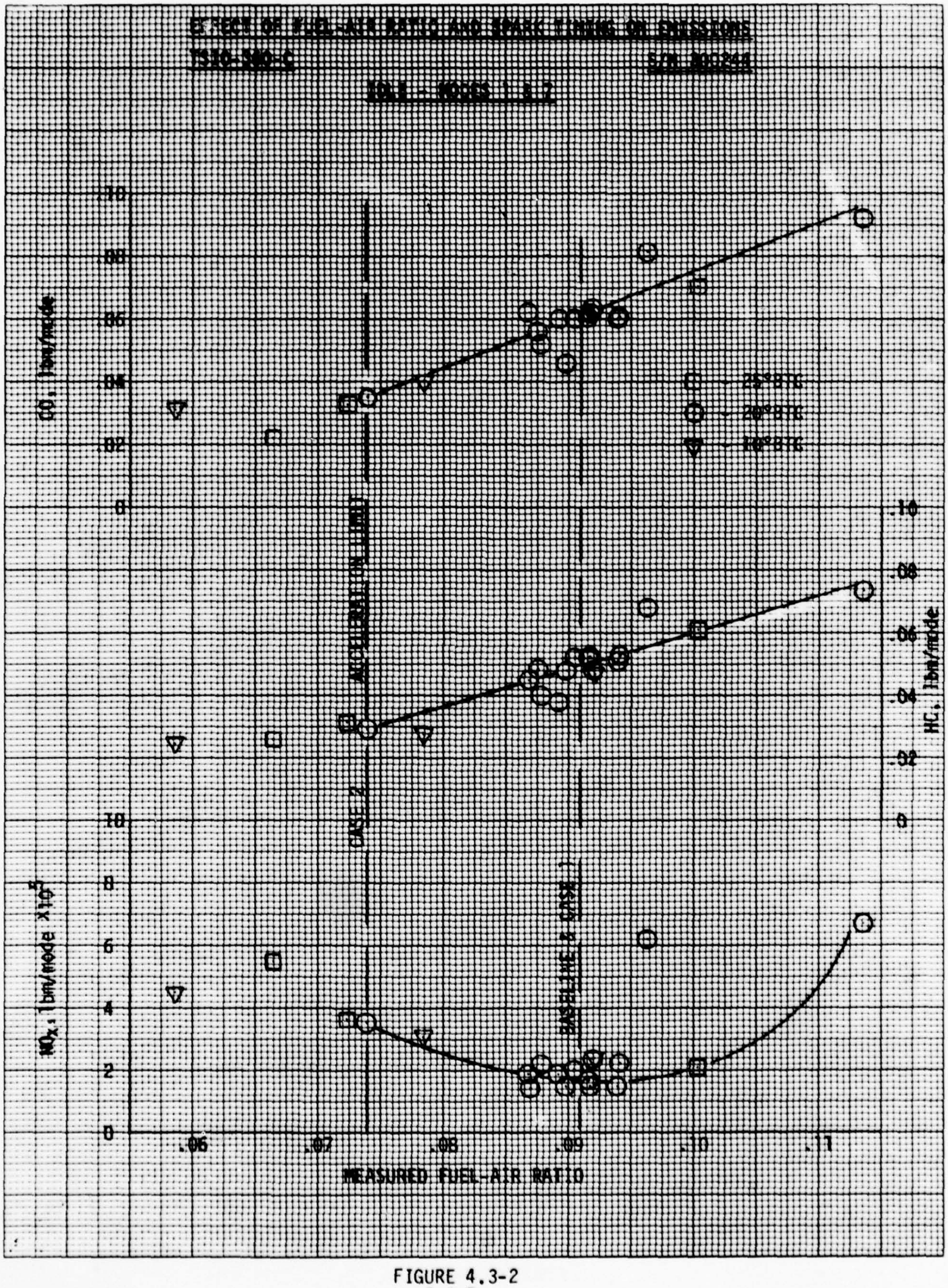

MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10
.11
CO, lbm/mode
.10
.08
.06
.04
.02
0
HC, lbm/mode
.10
.08
.06
.04
.02
0
10
8
6
4
2
0
ACCELERATION LIMIT
CASE 2
BASELINE & CASE 1

FIGURE 4.3-2

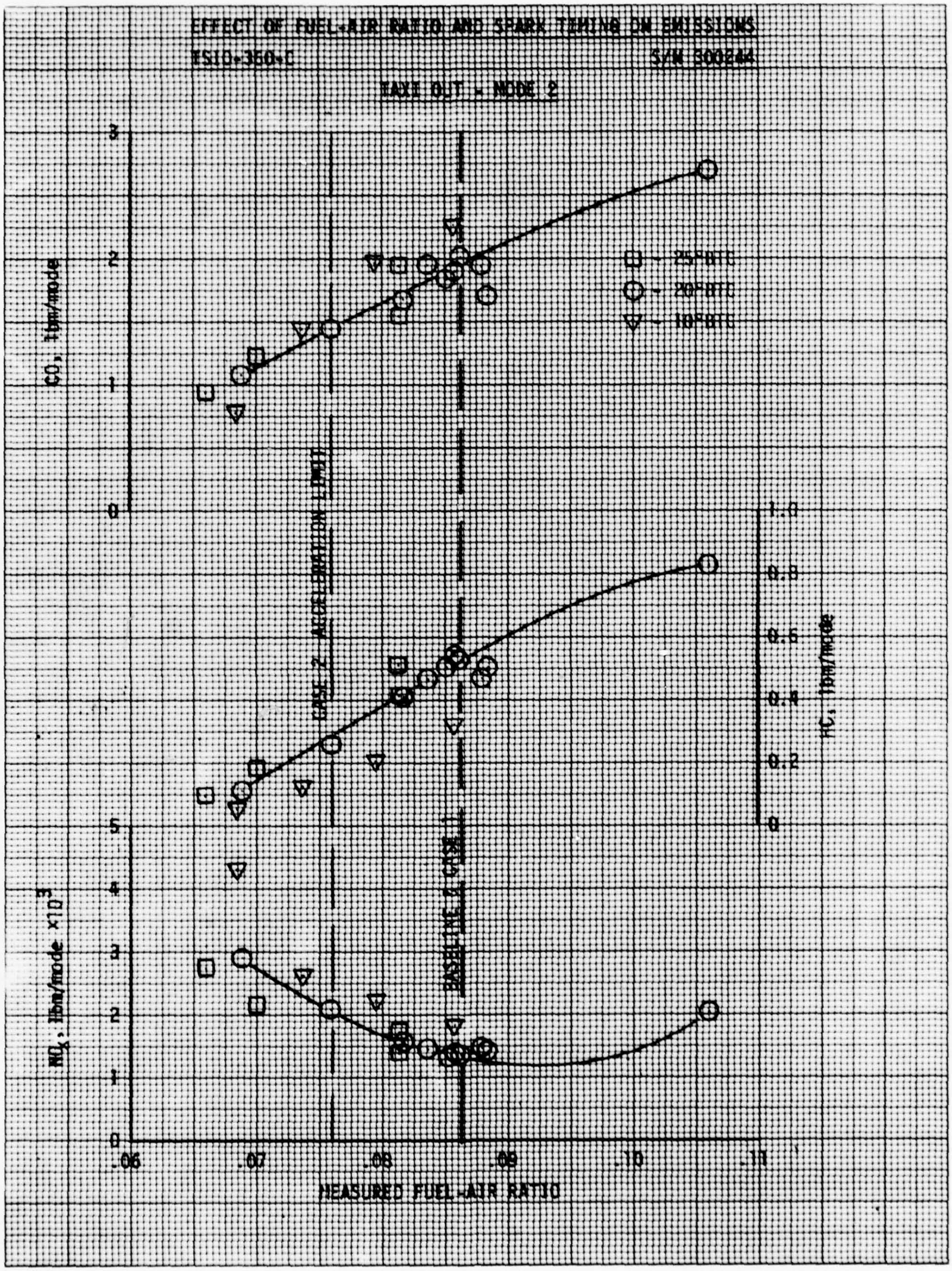

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
TSIO-360-C
S/N 300244
TAXI OUT - MODE 2
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode ×10^3
□ - 25°BTC
○ - 20°BTC
▽ - 10°BTC
CASE 2 ACCELERATION LIMIT
BASELINE & CASE 1
MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10
.11

FIGURE 4.3-3

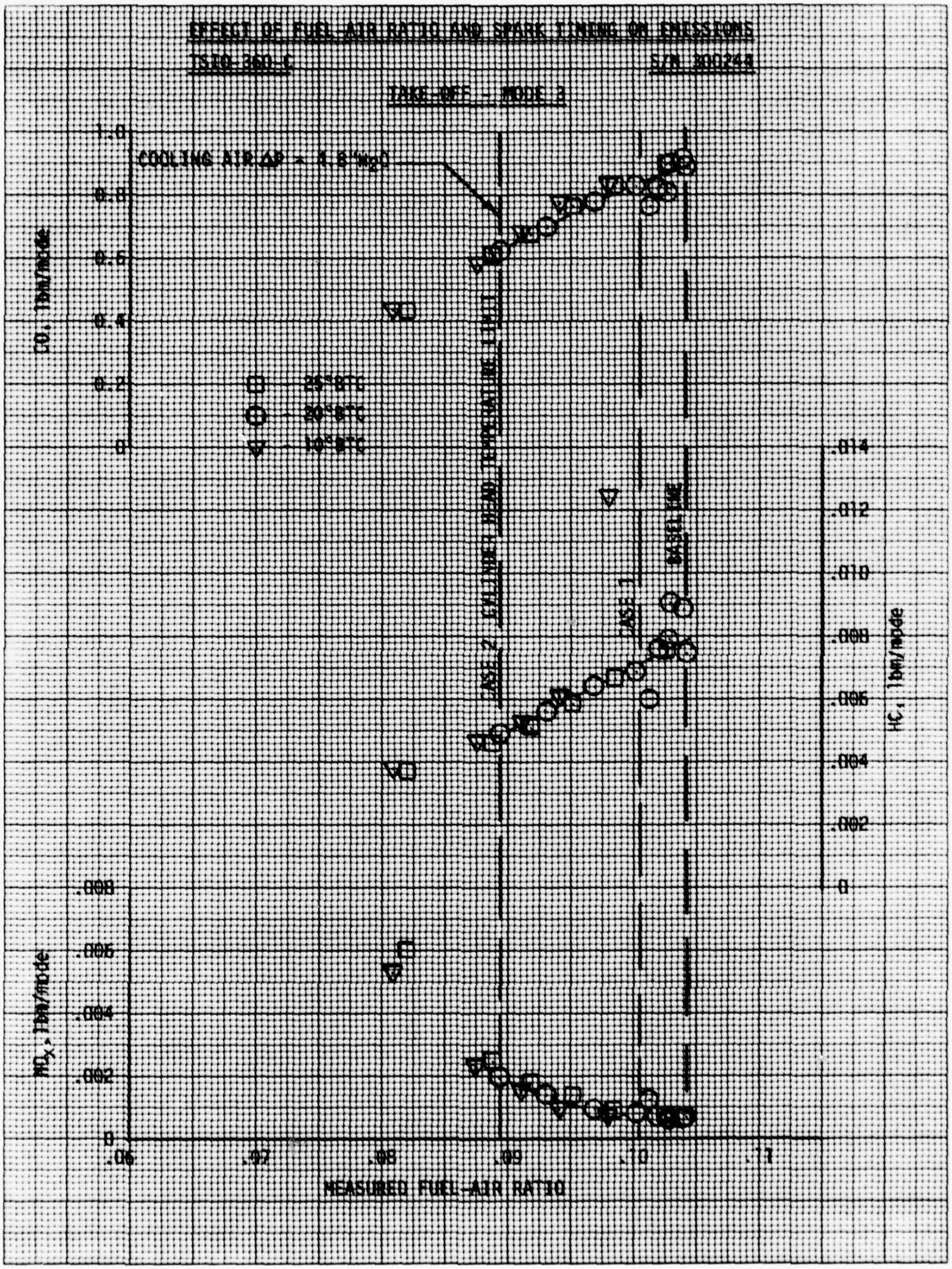

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
TSIO-360-C
S/N 300248
TAKE-OFF - MODE 3
COOLING AIR ΔP = 4.8"H2O
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
25°BTC
20°BTC
10°BTC
CYLINDER HEAD TEMPERATURE LIMIT
BASELINE
MEASURED FUEL-AIR RATIO

FIGURE 4.3-4

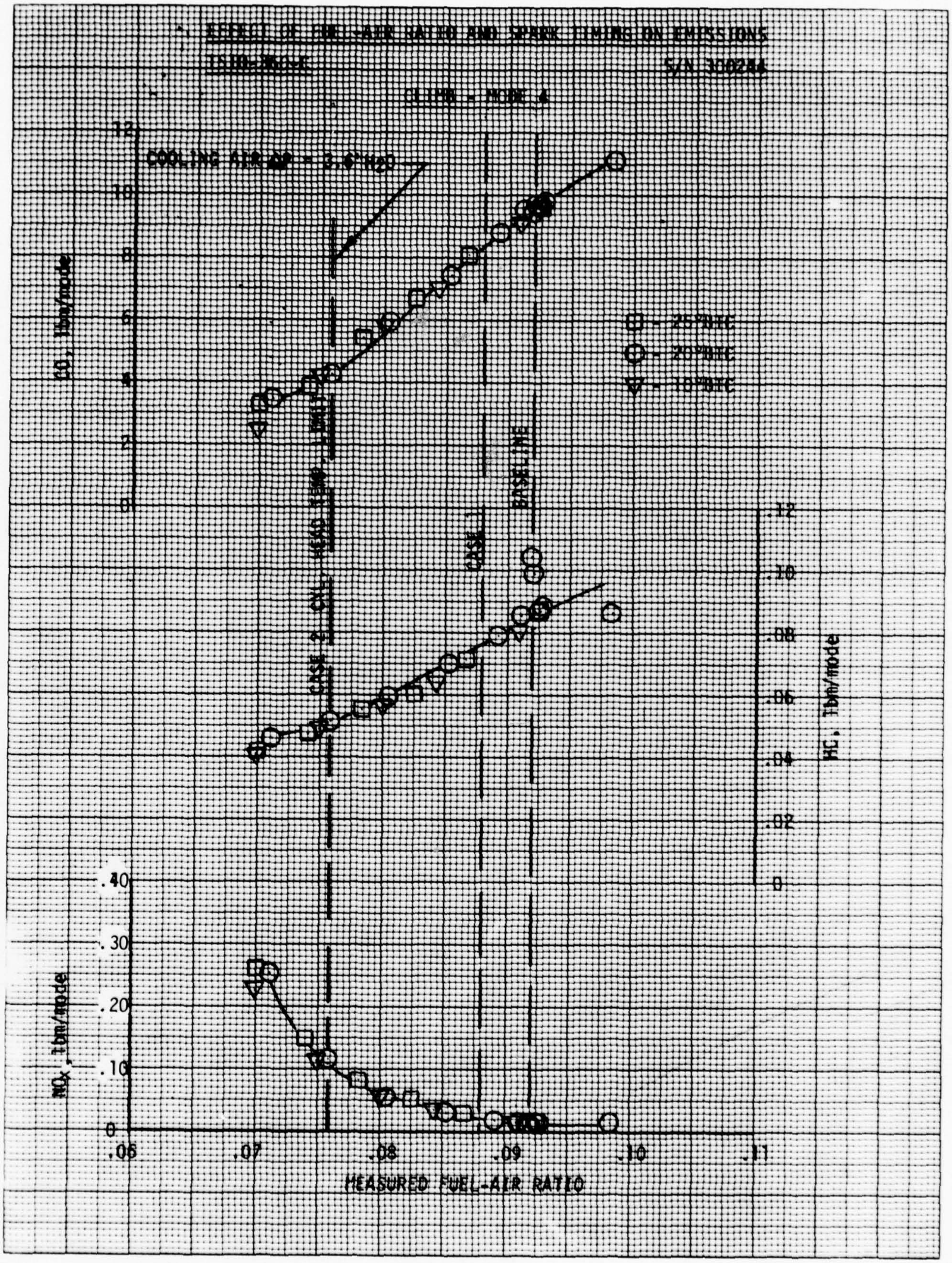
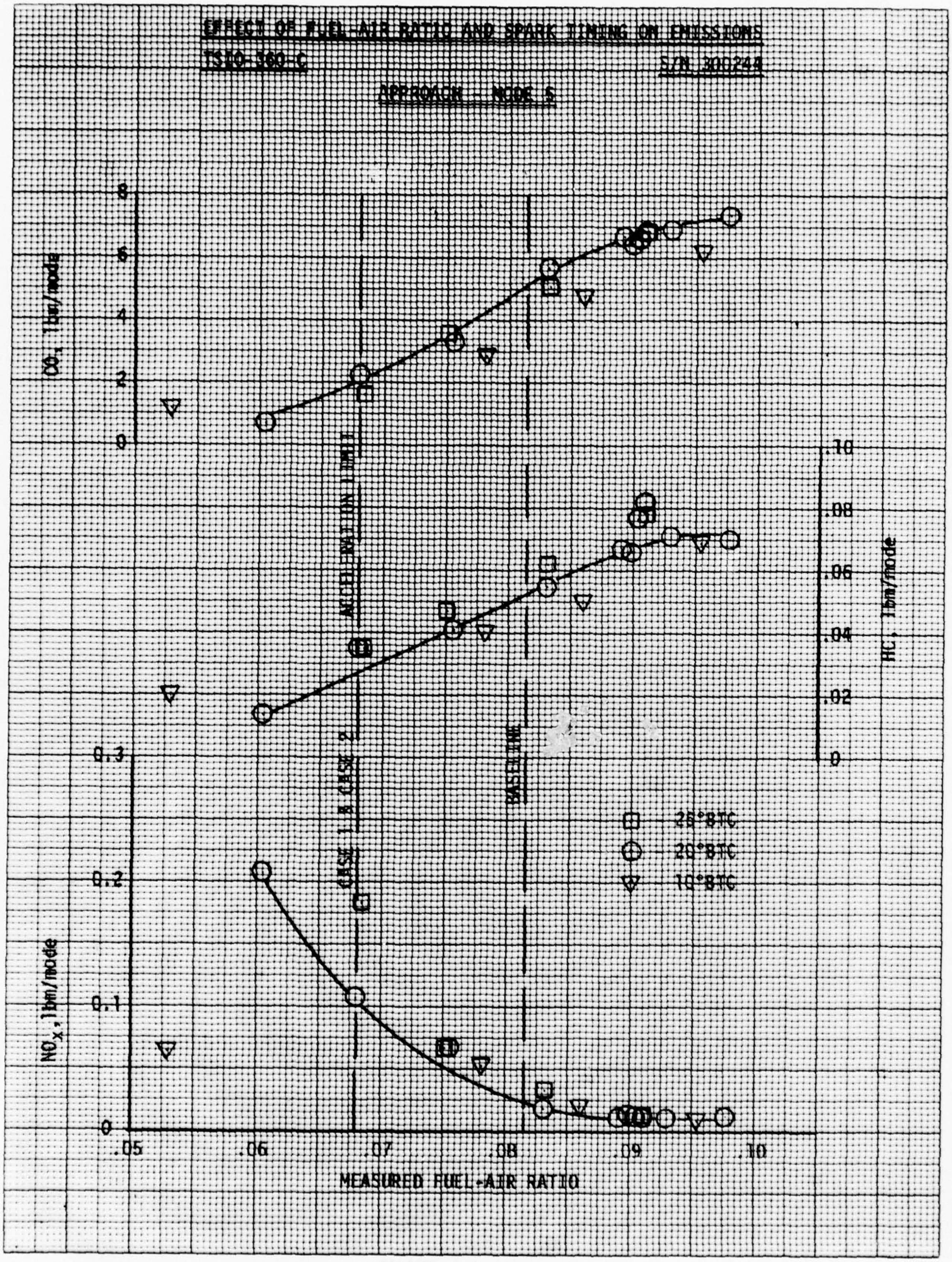
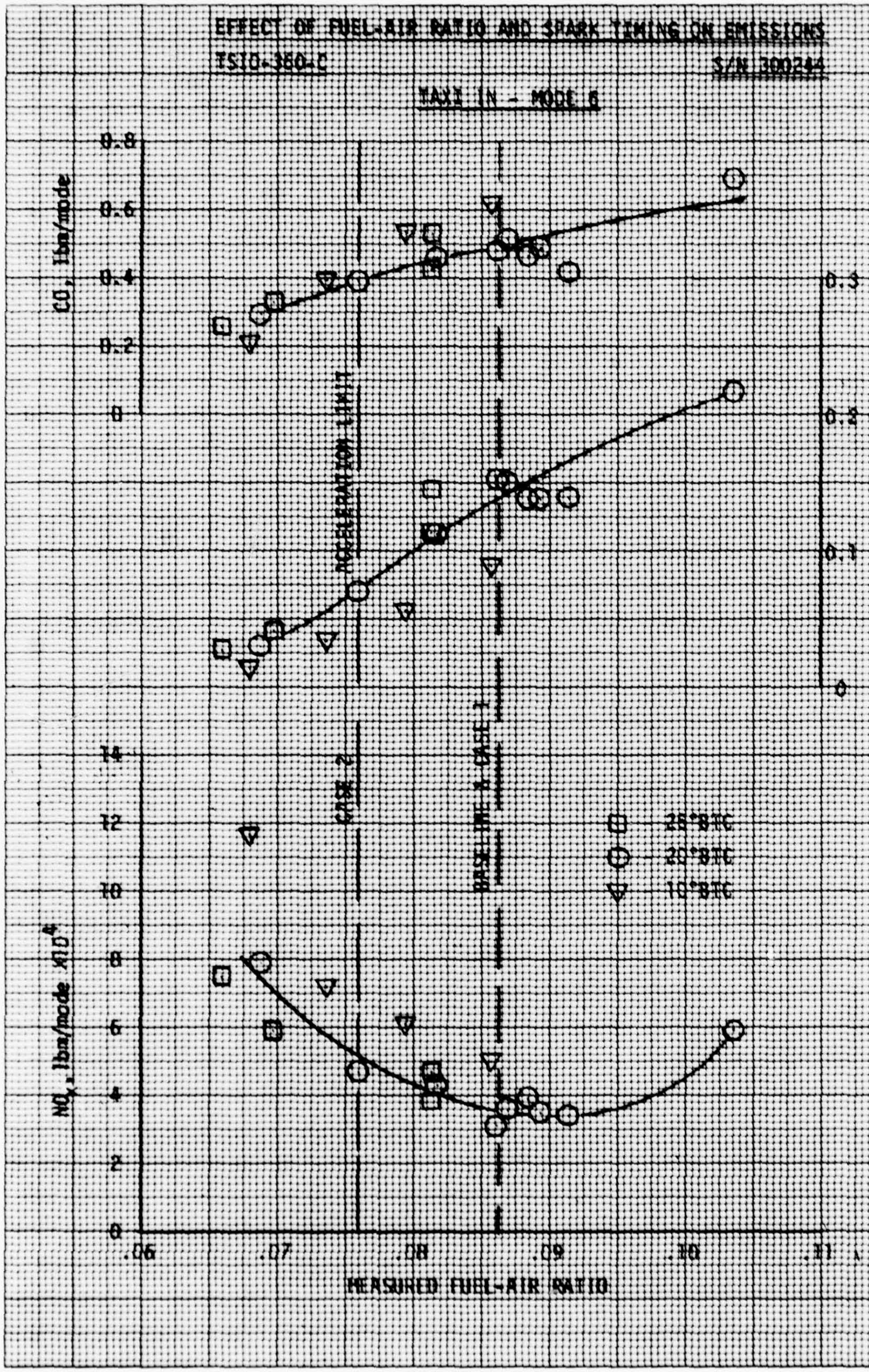

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
CLIMB - MODE 4
COOLING AIR ΔP = 3.6"H2O
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
CASE 1 - CYL. HEAD TEMP. LIMIT
CASE 2
BASELINE
- 25°BTC
- 20°BTC
- 10°BTC
MEASURED FUEL-AIR RATIO

FIGURE 4.3-5



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
TSIO-360-C
S/N 300244
APPROACH - MODE 5
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
ACCELERATION LIMIT
CASE 1 & CASE 2
BASELINE
25°BTC
20°BTC
10°BTC
MEASURED FUEL-AIR RATIO

FIGURE 4.3-6



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
TSIO-360-C
S/N 300244
TAXI IN - MODE 6
CO, lbm/mode
0.8
0.6
0.4
0.2
0
0.3
0.2
0.1
0
HC, lbm/mode
ACCELERATION LIMIT
CASE 2
BASELINE & CASE 1
25°BTC
20°BTC
10°BTC
NO_x, lbm/mode X10^4
14
12
10
8
6
4
2
0
.06
.07
.08
.09
.10
.11
MEASURED FUEL-AIR RATIO

FIGURE 4.3-7

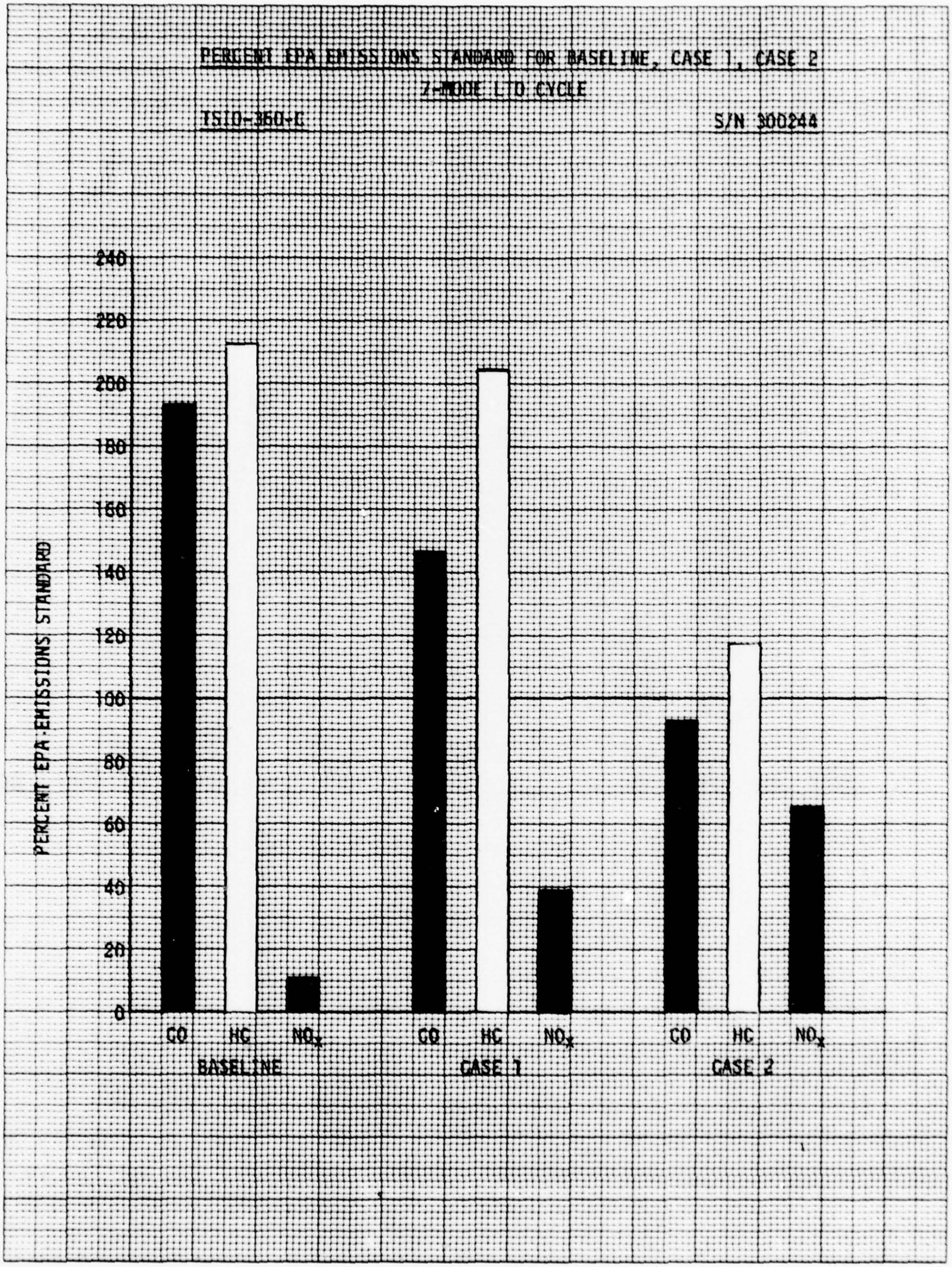

PERCENT EPA EMISSIONS STANDARD FOR BASELINE, CASE 1, CASE 2
7-MODE LTO CYCLE
TSIO-360-C
S/N 300244
PERCENT EPA EMISSIONS STANDARD
240
220
200
180
160
140
120
100
80
60
40
20
0
CO
HC
NO_x
BASELINE
CO
HC
NO_x
CASE 1
CO
HC
NO_x
CASE 2

FIGURE 4.3-8

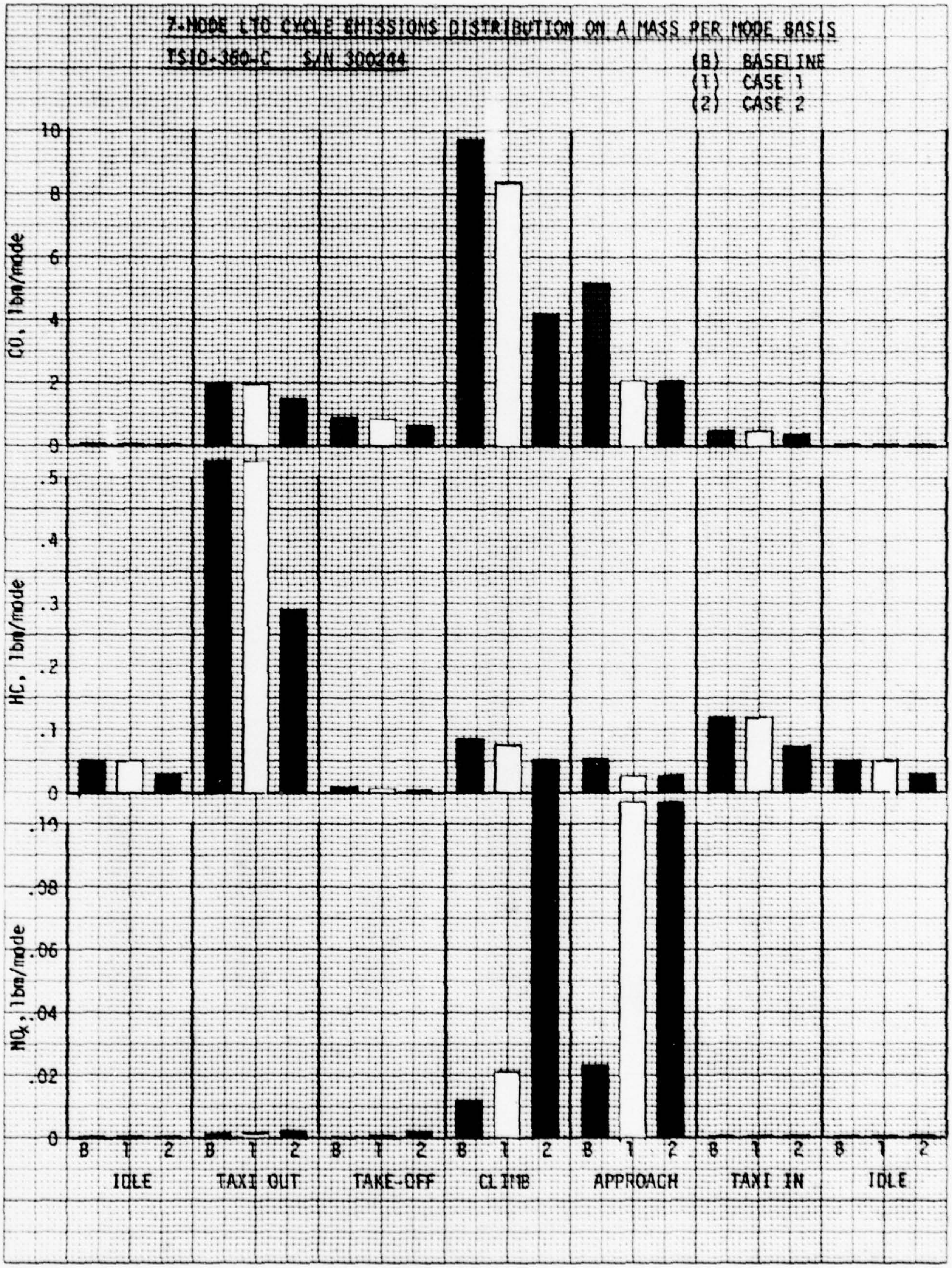

7-MODE LTO CYCLE EMISSIONS DISTRIBUTION ON A MASS PER MODE BASIS
TSIO-360-C S/N 300244
(B) BASELINE
(1) CASE 1
(2) CASE 2
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
B 1 2 B 1 2 B 1 2 B 1 2 B 1 2 B 1 2 B 1 2
IDLE
TAXI OUT
TAKE-OFF
CLIMB
APPROACH
TAXI IN
IDLE

FIGURE 4.3-9

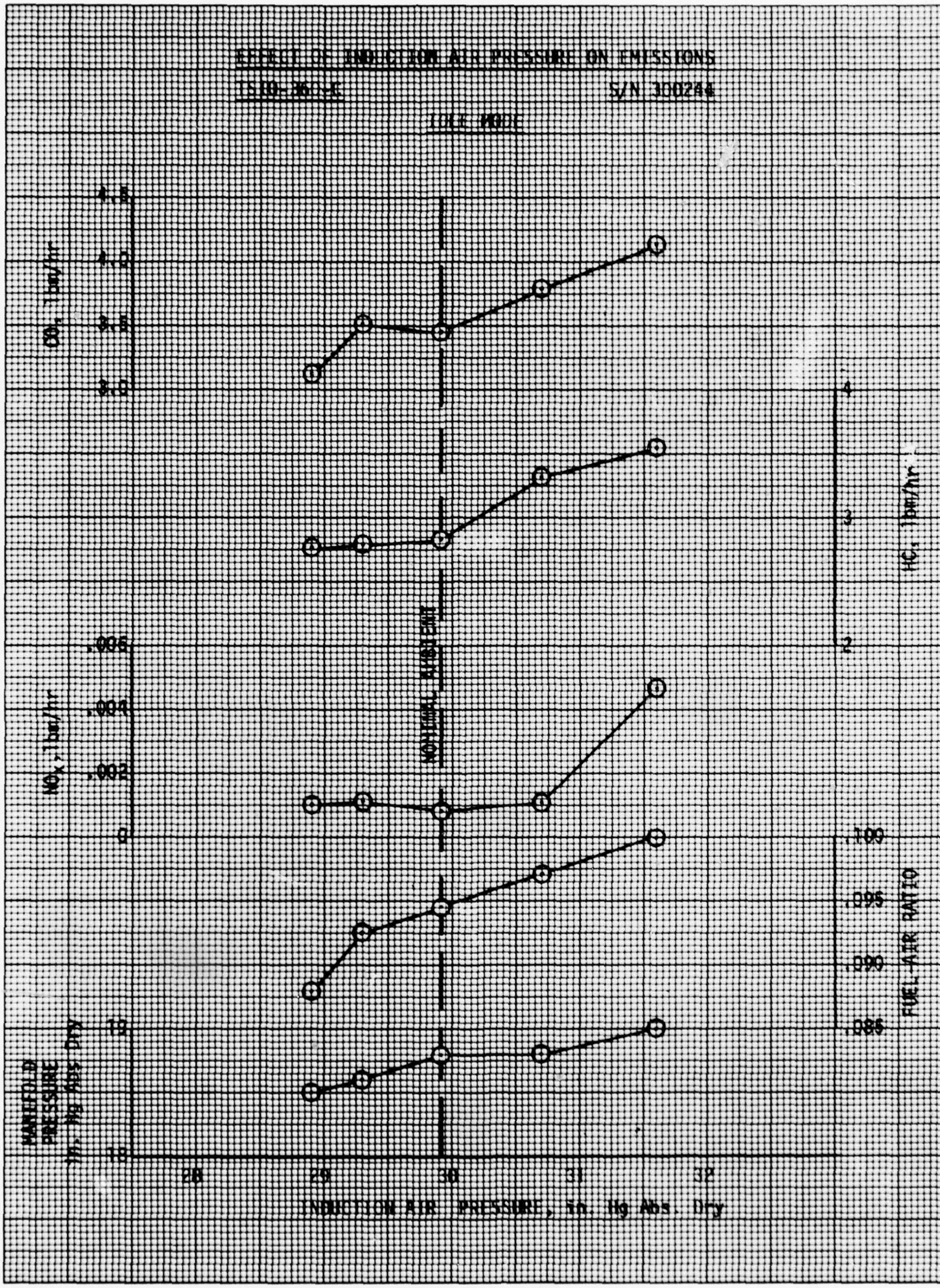

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TSIO-360-C
S/N 300244
IDLE MODE
CO, lbm/hr
3.0
3.5
4.0
4.5
HC, lbm/hr
2
3
4
NOx, lbm/hr
0
.002
.004
.006
NOMINAL AMBIENT
FUEL-AIR RATIO
.085
.090
.095
.100
MANIFOLD PRESSURE in. Hg Abs Dry
10
15
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.3-10

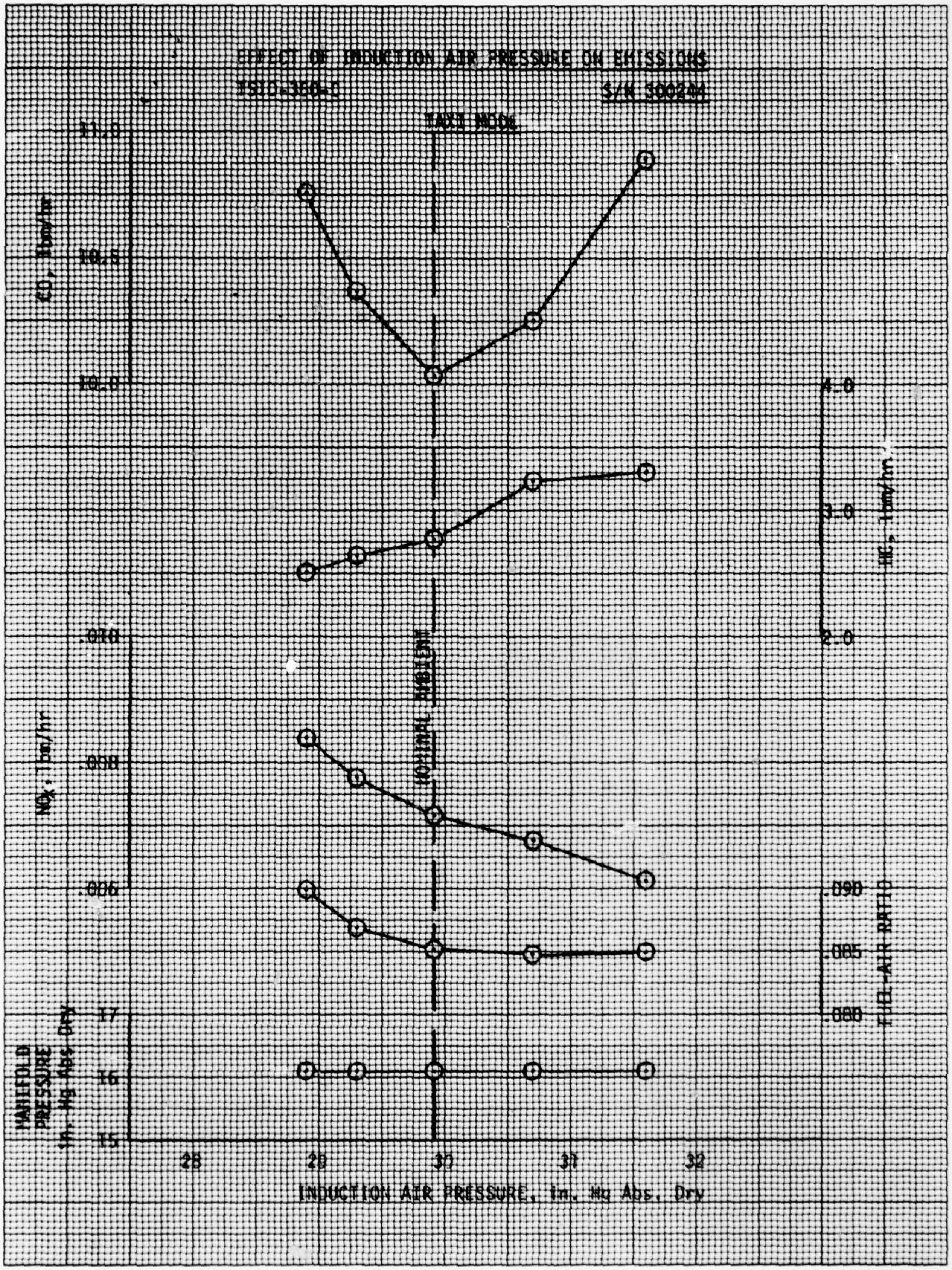

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TSIO-360-C
S/N 300244
TAXI MODE
CO, lbm/hr
11.0
10.5
10.0
HC, lbm/hr
4.0
3.0
2.0
NOx, lbm/hr
.010
.008
.006
NOMINAL AMBIENT
FUEL-AIR RATIO
.090
.085
.080
MANIFOLD PRESSURE In. Hg Abs. Dry
17
16
15
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.3-11

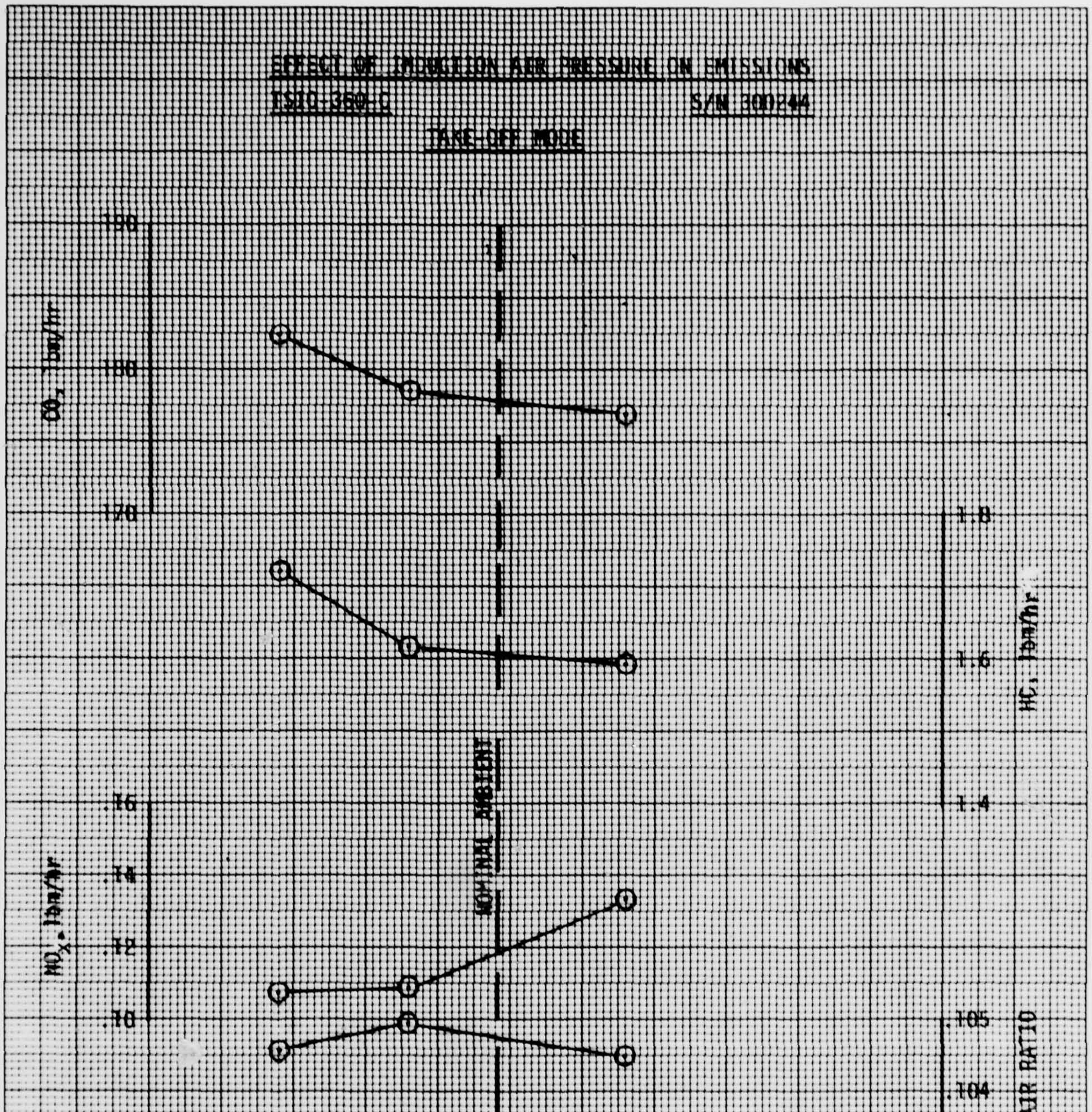

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TSIO-360-C
S/N 300244
TAKE-OFF MODE
CO, lbm/hr
190
180
170
HC, lbm/hr
1.8
1.6
1.4
NOMINAL AMBIENT
NO_x, lbm/hr
.16
.14
.12
.10
FUEL-AIR RATIO
.105
.104
.103
MANIFOLD PRESSURE In. Hg Abs-Dry
38
37
36
28
29
30
31
32
INDUCTION AIR PRESSURE, In. Hg Abs. Dry

FIGURE 4.3-12

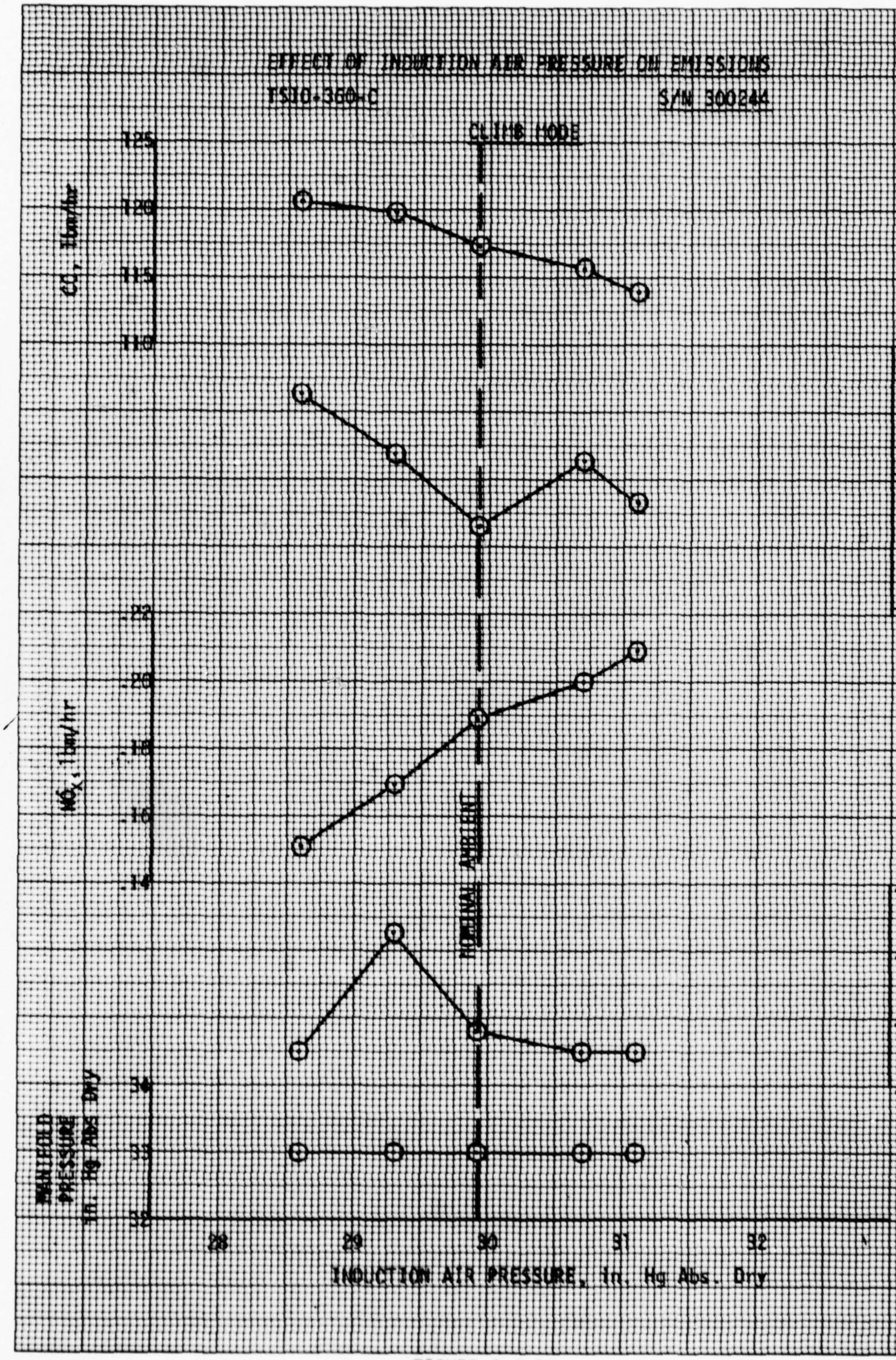

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TSIO-360-C
S/N 300244
CLIMB MODE
CO, lbm/hr
125
120
115
110
HC, lbm/hr
1.20
1.10
1.00
NO_x, lbm/hr
.22
.20
.18
.16
.14
NOMINAL AMBIENT
FUEL-AIR RATIO
.095
.094
.093
.092
MANIFOLD PRESSURE In. Hg Abs Dry
34
33
32
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.3-13

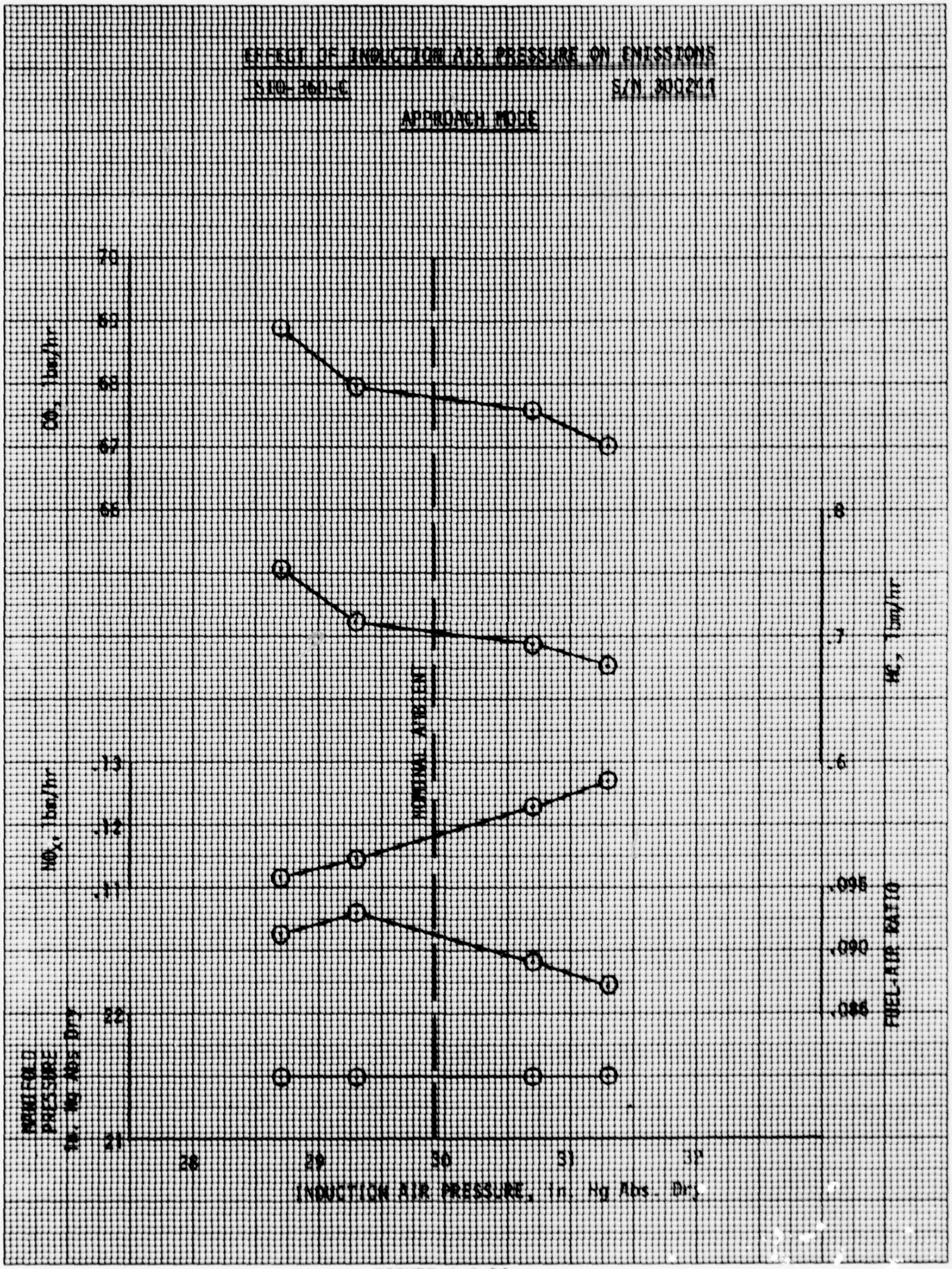
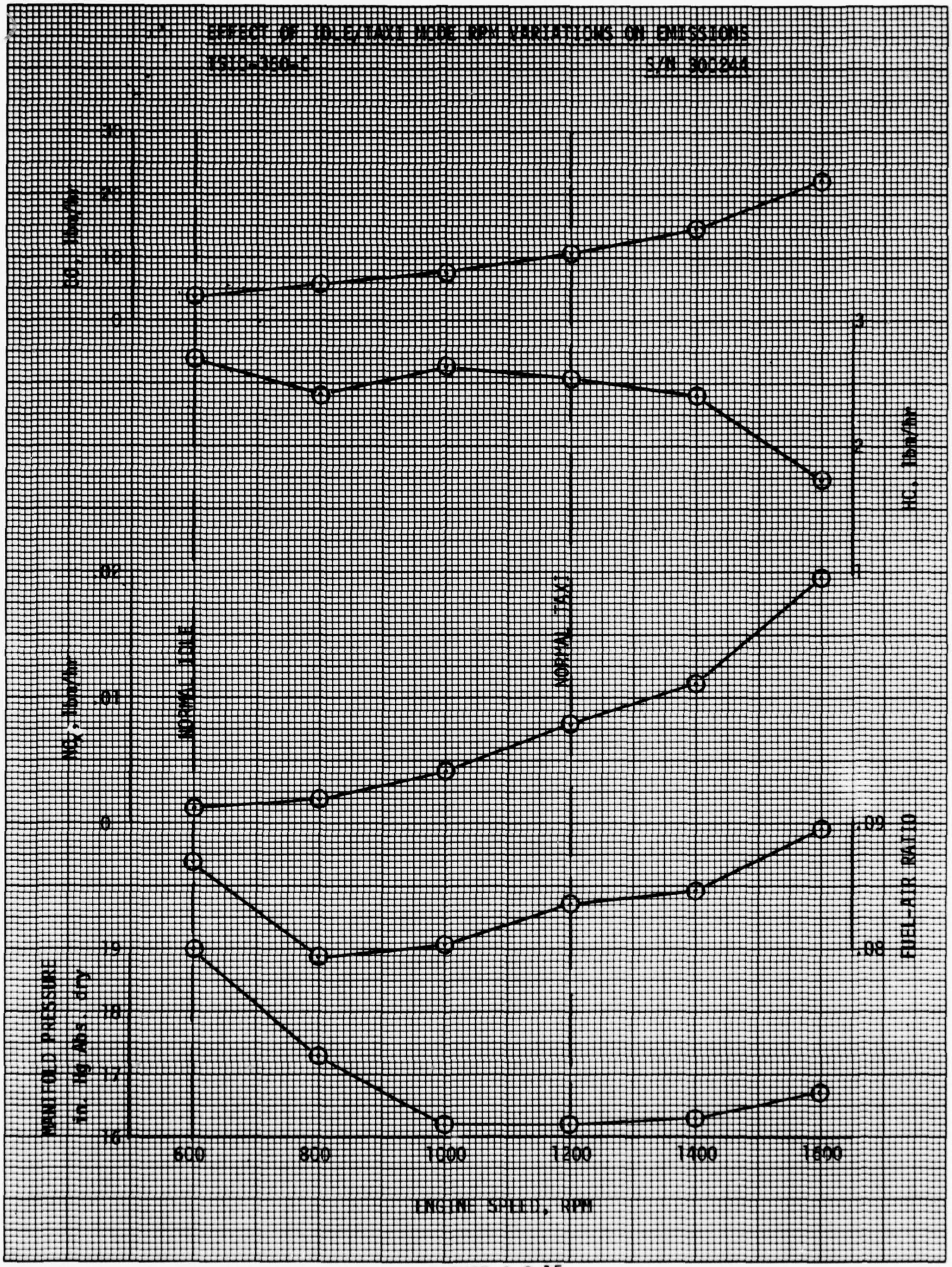

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TSIO-360-C
APPROACH MODE
CO, lbm/hr
70
69
68
67
66
HC, lbm/hr
.8
.7
.6
NO_x, lbm/hr
.13
.12
.11
FUEL-AIR RATIO
.095
.090
.085
MANIFOLD PRESSURE in. Hg Abs Dry
22
21
NOMINAL AMBIENT
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.3-14



EFFECT OF IDLE/TAXI MODE RPM VARIATIONS ON EMISSIONS
CO, lbm/hr
HC, lbm/hr
NOx, lbm/hr
FUEL-AIR RATIO
MANIFOLD PRESSURE
in. Hg Abs. dry
NORMAL IDLE
NORMAL TAXI
600
800
1000
1200
1400
1600
ENGINE SPEED, RPM

FIGURE 4.3-15

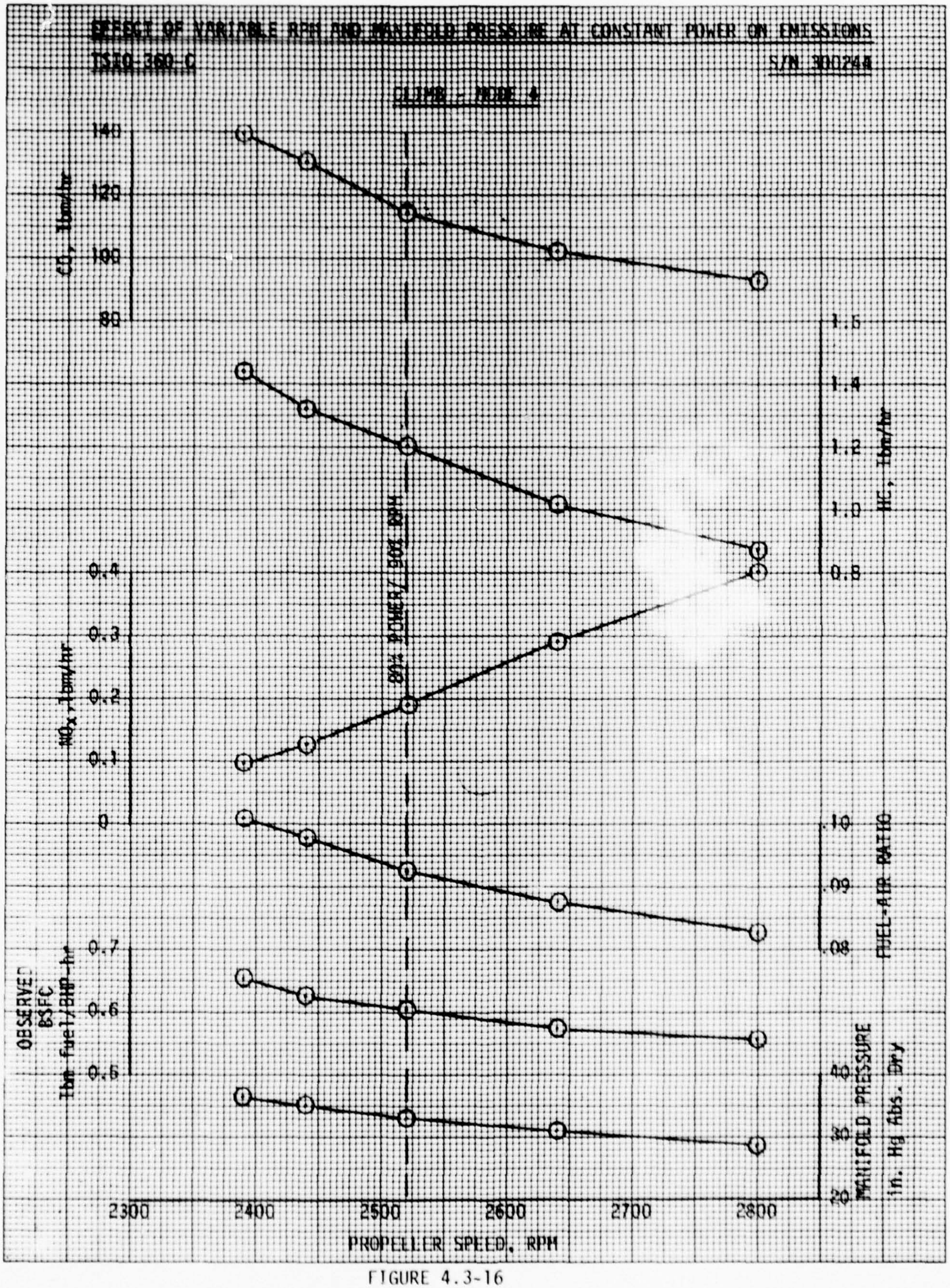

EFFECT OF VARIABLE RPM AND MANIFOLD PRESSURE AT CONSTANT POWER ON EMISSIONS
TSIO-360-C
S/N 300244
CLIMB - MODE 4
CO, lbm/hr
HC, lbm/hr
NOx, lbm/hr
80% POWER/ 90% RPM
FUEL-AIR RATIO
OBSERVED BSFC lbm fuel/BHP-hr
MANIFOLD PRESSURE In. Hg Abs. Dry
PROPELLER SPEED, RPM
2300
2400
2500
2600
2700
2800

FIGURE 4.3-16

4.4 Tiara 6-285-B Exhaust Emission Test Results

The Tiara 6-285-B is a modern, high-speed, geared engine with the TCM continuous flow fuel injection system. The fuel injection system controls fuel flow in response to engine speed, throttle position and manifold pressure. In addition, a two-stage fuel pump is used with an inter-stage aneroid controller which regulates inlet pressure to the second pump stage.

The induction system is a "spider" type manifold, which, along with precise fuel delivery to the intake ports, provides excellent fuel-air charge uniformity to each cylinder.

The combustion chamber design provides high combustion turbulence resulting in excellent lean operating characteristics. The exhaust emissions for the Tiara at the BASELINE operating condition are the best overall of any of the other four engines tested, due to its leaner operation (Ref. 19).

The Type Certificate recommended fuel flow curve is shown in Figure 4.4-1, where BASELINE fuel flow is the average full rich fuel flow and CASE 1 fuel flow is at the lean limit above 75% power and at the minimum allowable fuel flow below 75% power.

Figures 4.4-2 thru 4.4-7 show the effect on emissions of individual modal leaning for 7-Mode LTO Cycle. The major effect of spark advance is clearly demonstrated in Figures 4.4-4, -5 and -6 in the Take-Off, Climb and Approach Modes. Advancing the magneto timing beyond the normal 30° BTC results in the extension of the lean misfire limit. For the normal timing at Climb, the engine begins to misfire at a fuel-air ratio of 0.058. By advancing the timing to 40°, 45° and 50° BTC the lean misfire limit was extended to 0.053, 0.048 and 0.047, respectively. For a constant magneto timing, however, a penalty is paid in increased cooling requirements for a given fuel-air ratio as timing is advanced. In the Climb Mode for the Tiara, estimated cooling requirements limit the CASE 2 fuel-air ratio to 0.075.

Advancing the timing from 30° to 50° BTC at a fuel-air ratio of about 0.082 will require over twice the cooling air pressure to maintain the same cylinder head temperature. Translated into aircraft forward motion, the airpseed would have to be about 46% higher to provide the additional ram air for equivalent cooling in the climb mode. This data indicates very clearly the cooling limitation to the reduction of emissions in the climb mode.

Figure 4.4-8 illustrates the BASELINE, CASE 1 and CASE 2 emissions levels with respect to the 7-Mode LTO Cycle. Only for CASE 2 operation were all three pollutants within the EPA Standards.

The distribution of the emissions among the seven modes is shown in Figure 4.4-9. The Climb and Approach Modes were the principal contributors to all three pollutants with the Taxi Out Mode contributing significantly to HC and CO production.

The effect of induction air pressure on emissions for this engine is presented in Figures 4.4-10 thru 4.4-14. Basically, an increase in induction air pressure tended to increase air flow for each mode. The result was lower fuel-air ratios with emissions of CO, HC decreasing and NO_x increasing as would be expected.

In Figure 4.4-15, the variation of emissions with propeller speed for low powers is shown. A similar trend is shown as that for the TSIO-360-C engine (Figure 4.3-15). CO and NO_x increase with increasing RPM (power) and HC emissions are reduced due to improved combustion turbulence, increased exhaust gas temperature and better fuel-air mixture homogeneity.

Figures 4.4-16 and 4.4-17 show the variation of emissions at constant 80% and 40% powers, when RPM and manifold pressure are varied. Both curves show that the low RPM, high manifold pressure settings tend to reduce CO and HC emissions. The 40% power test was run twice with similar results. The range of speeds for this mode was limited by the propeller governor which becomes inactive at speeds below 1500 RPM at this power setting.

TABLE 4.4-1

TIARA 6-285-B ENGINE DESCRIPTION

TYPE CERTIFICATE NUMBER	E12CE
DATE OF ISSUANCE	1/29/71
NUMBER OF CYLINDERS	6
CUBIC INCH DISPLACEMENT	405.97
CYLINDER BORE (inches)	4.875
PISTON STROKE (inches)	3.625
COMPRESSION RATIO	9.0:1
DRIVE RATIO (propeller/crankshaft)	0.5:1
AIR INDUCTION SYSTEM	NATURALLY ASPIRATED
FUEL CONTROL SYSTEM	FUEL INJECTED
RATED MAXIMUM TAKE-OFF POWER	285 BHP
RATED MAXIMUM TAKE-OFF PROPELLER RPM	2000 RPM
RATED MAXIMUM CONTINUOUS POWER	285 BHP
RATED MAXIMUM CONTINUOUS PROPELLER RPM	2000 RPM
MAXIMUM ALLOWABLE CYLINDER HEAD TEMPERATURE	$460^{o}F$
MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE	--
MINIMUM FUEL OCTANE RATING	100/130 Avgas
IGNITION TIMING (degrees btc)	30^{o}

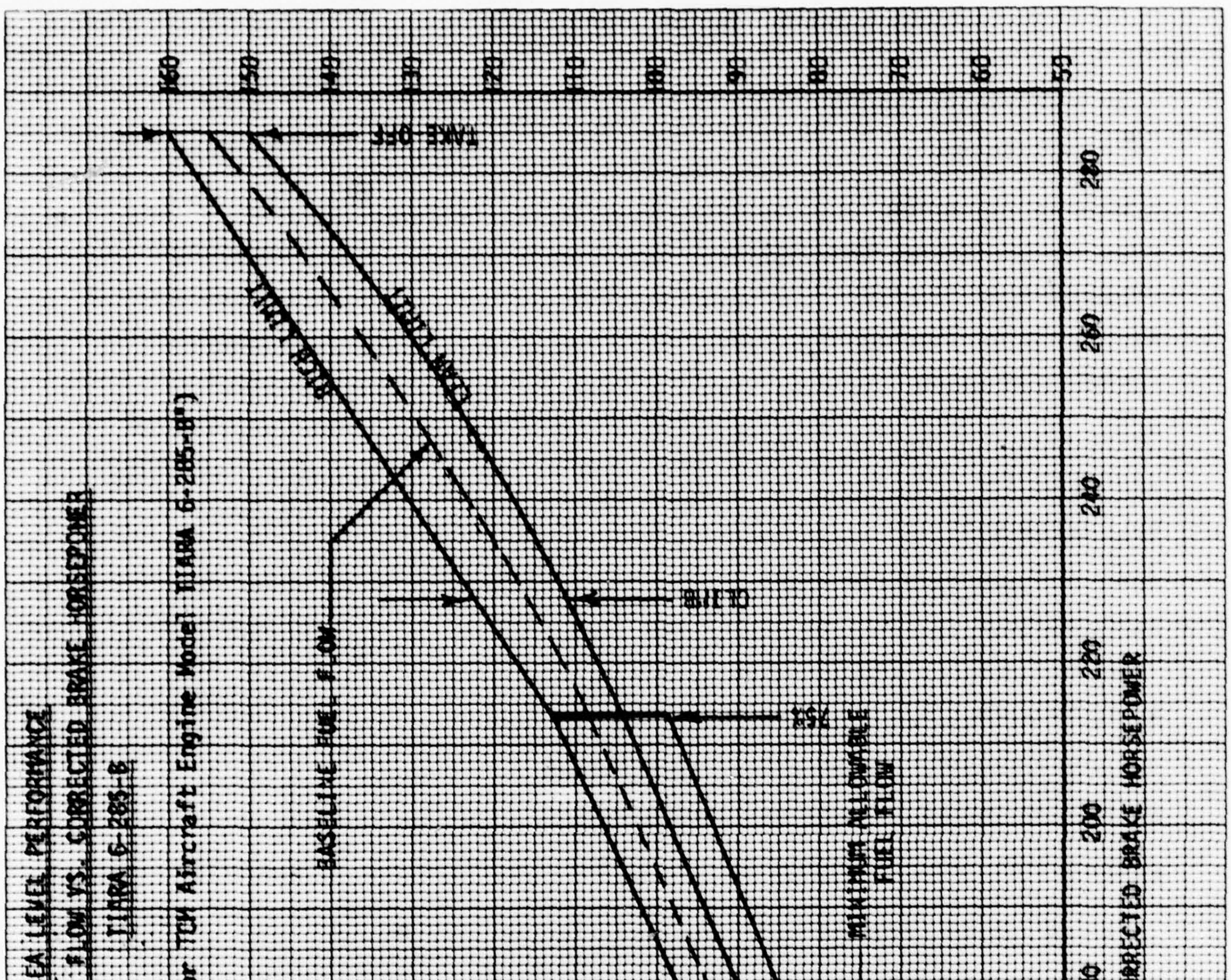

SEA LEVEL PERFORMANCE
RECOMMENDED FUEL FLOW VS. CORRECTED BRAKE HORSEPOWER
TIARA 6-285-B
(from "Detail Specification for TCM Aircraft Engine Model TIARA 6-285-B")
BASELINE FUEL FLOW
MINIMUM ALLOWABLE FUEL FLOW
TAKE OFF
CLIMB
75%
APPROACH
FUEL FLOW, lbs/hr
CORRECTED BRAKE HORSEPOWER
50
60
70
80
90
100
110
120
130
140
150
160
120
140
160
180
200
220
240
260
280

FIGURE 4.4-1

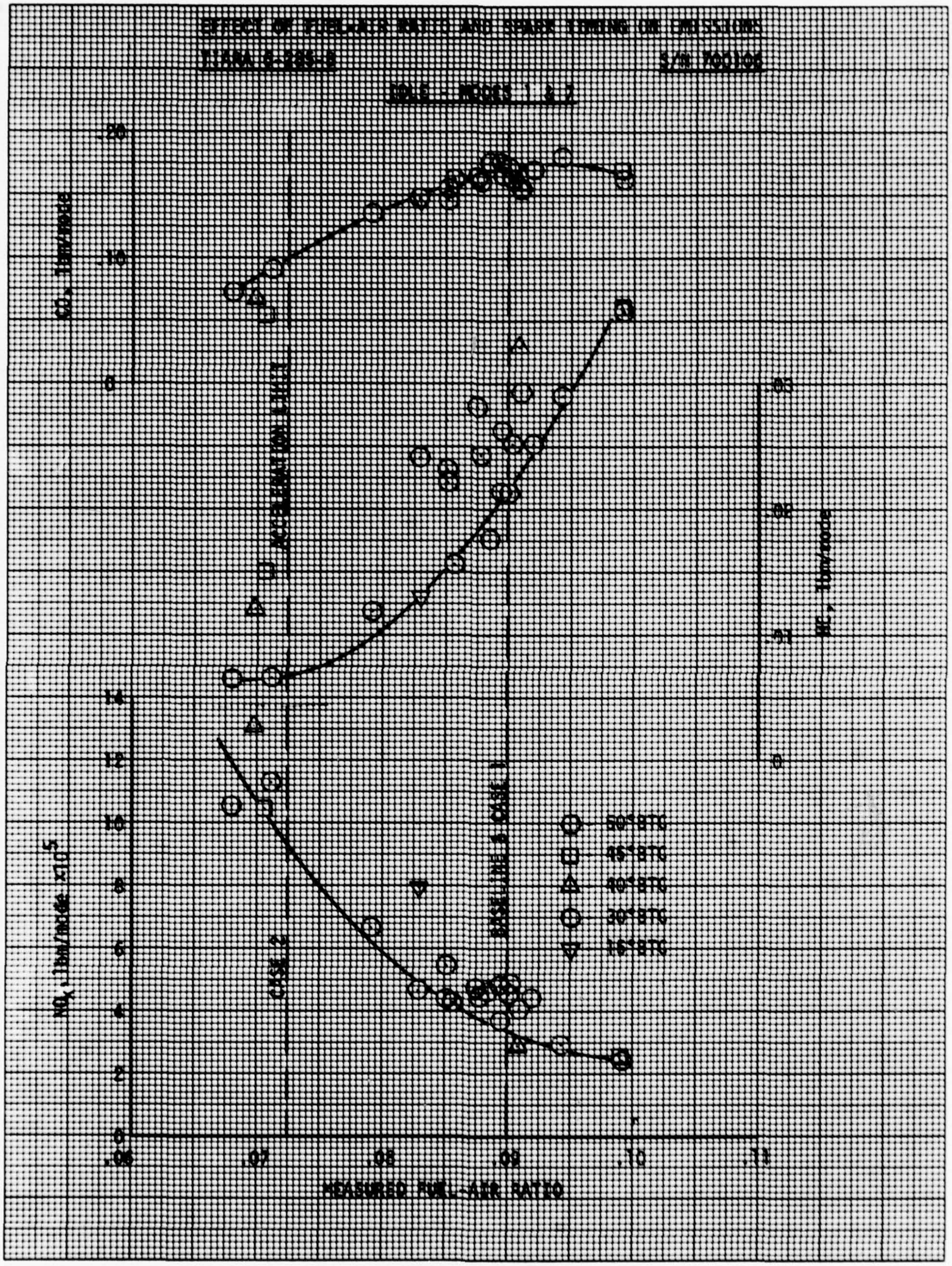

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
IDLE - MODES 1 & 7
ACCELERATION LIMIT
BASE LINE & CASE 1
CASE 2
.06
.07
.08
.09
.10
.11
MEASURED FUEL-AIR RATIO

FIGURE 4.4-2

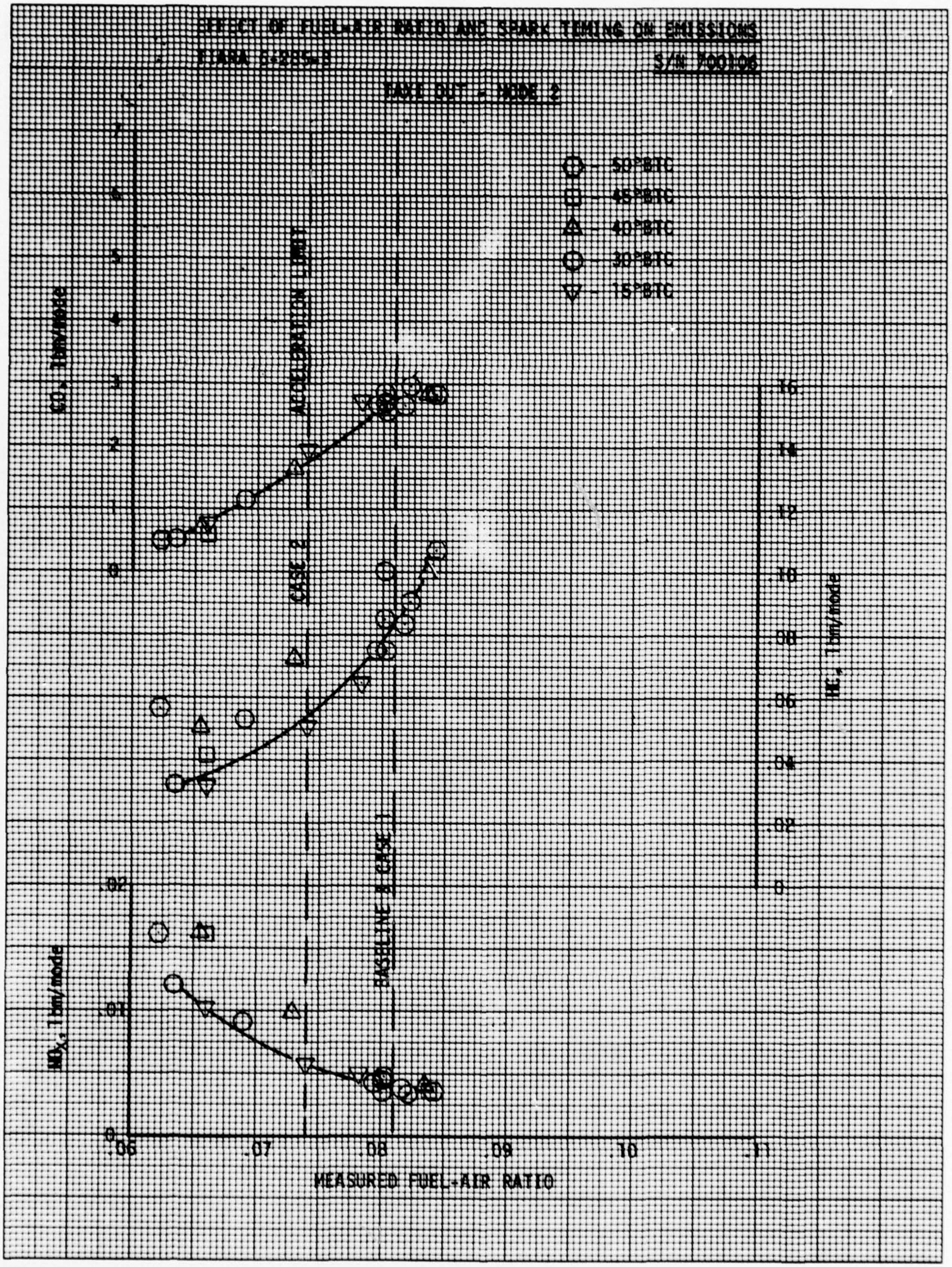
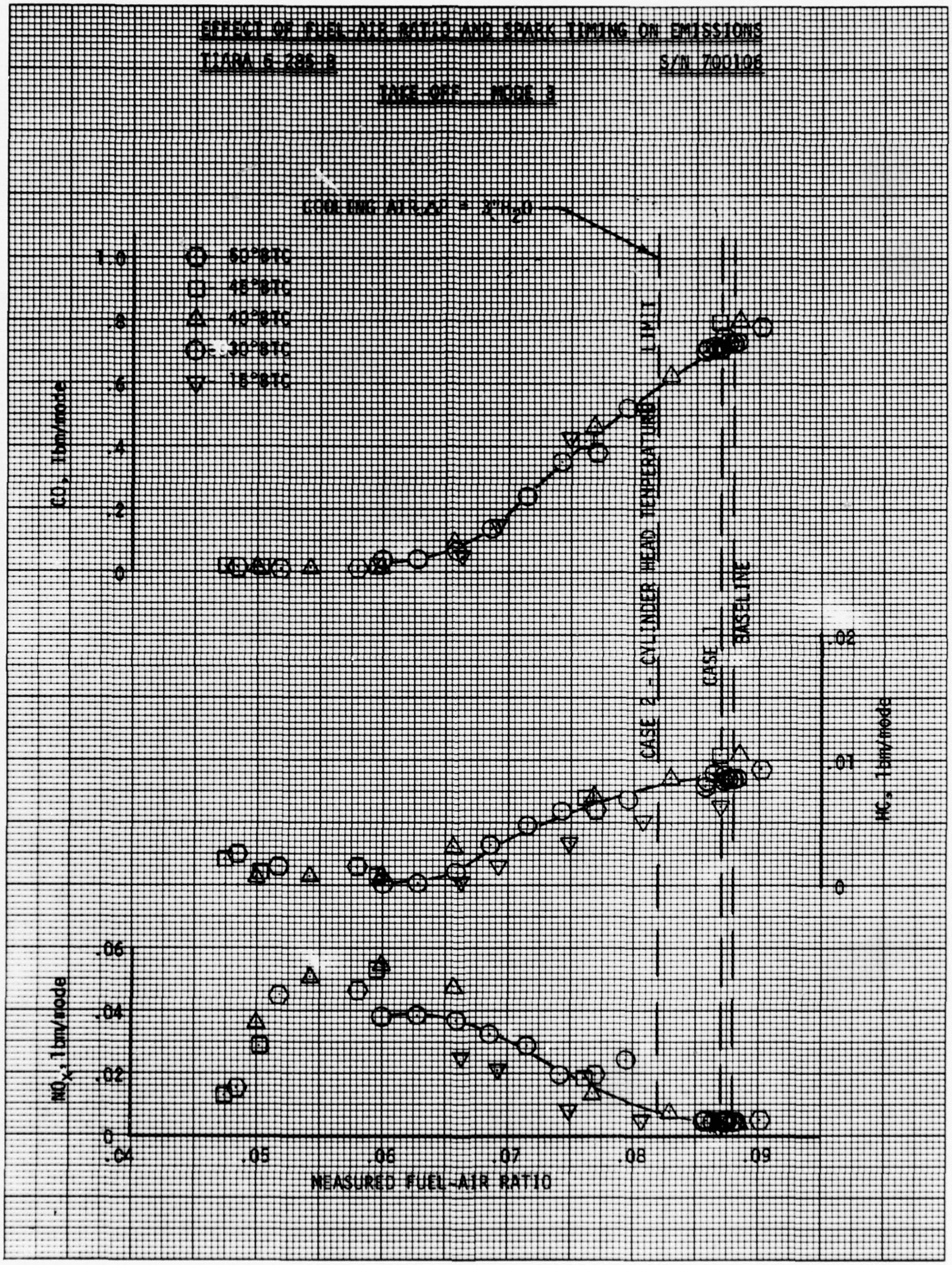

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
TIARA 6-285-3
S/N 700106
TAXI OUT - MODE 2
50°BTC
45°BTC
40°BTC
30°BTC
15°BTC
AUTOIGNITION LIMIT
CASE 2
BASELINE & CASE 1
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
MEASURED FUEL-AIR RATIO

FIGURE 4.4-3



EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
TIARA 6-285-B
S/N 700106
TAKE OFF - MODE 3
COOLING AIR ΔP = 3"H_2O
60°BTC
45°BTC
40°BTC
30°BTC
15°BTC
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
CASE 2 - CYLINDER HEAD TEMPERATURE LIMIT
CASE 1
BASELINE
MEASURED FUEL-AIR RATIO

FIGURE 4.4-4

FIGURE 4.3-10
4.3-13

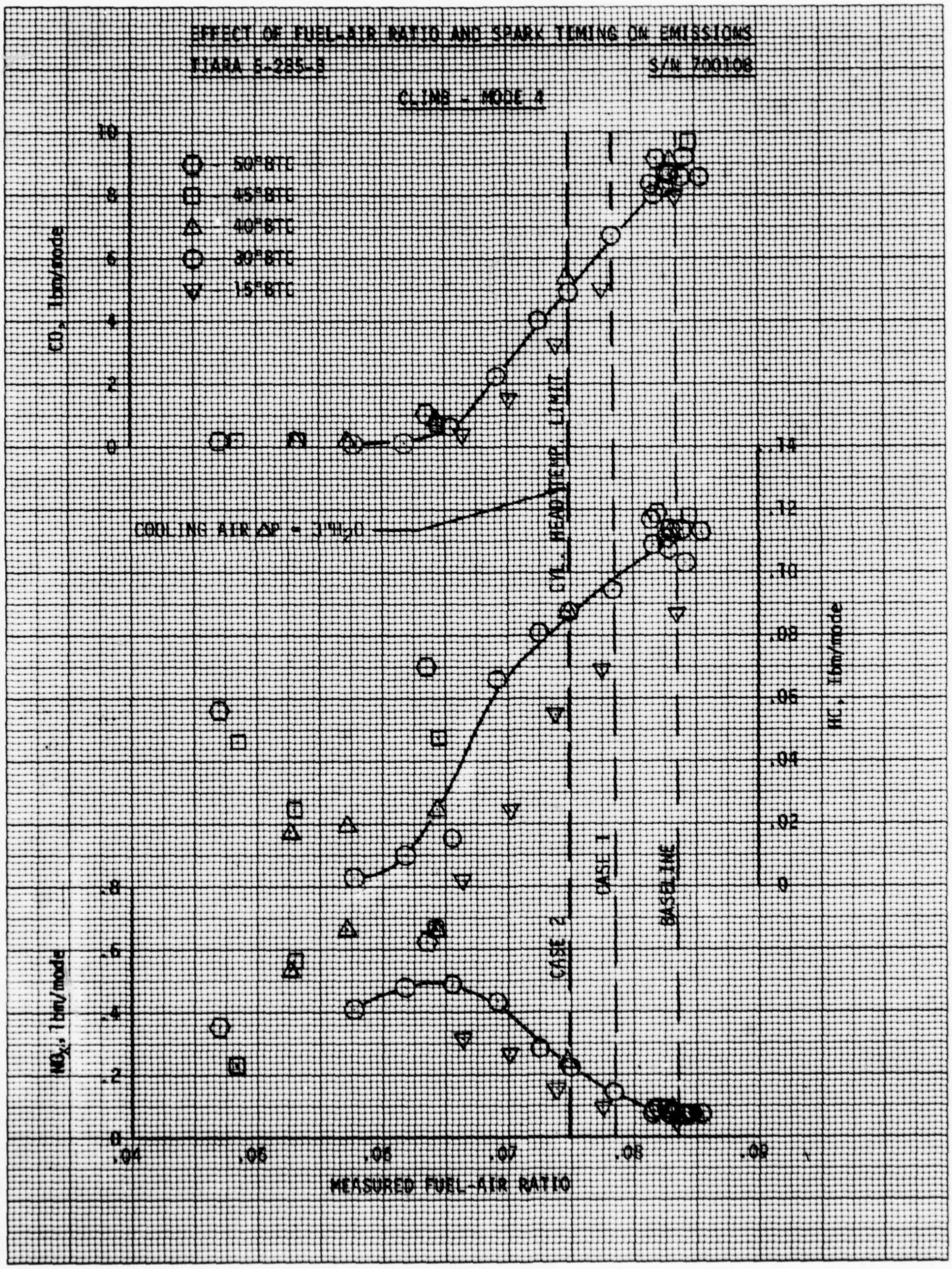


FIGURE 4.4-5

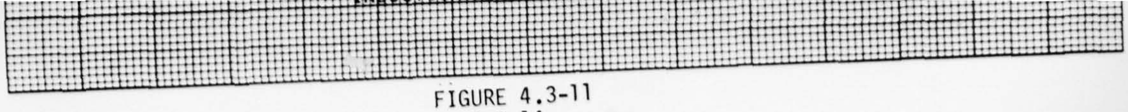


FIGURE 4.3-11
4.3-14

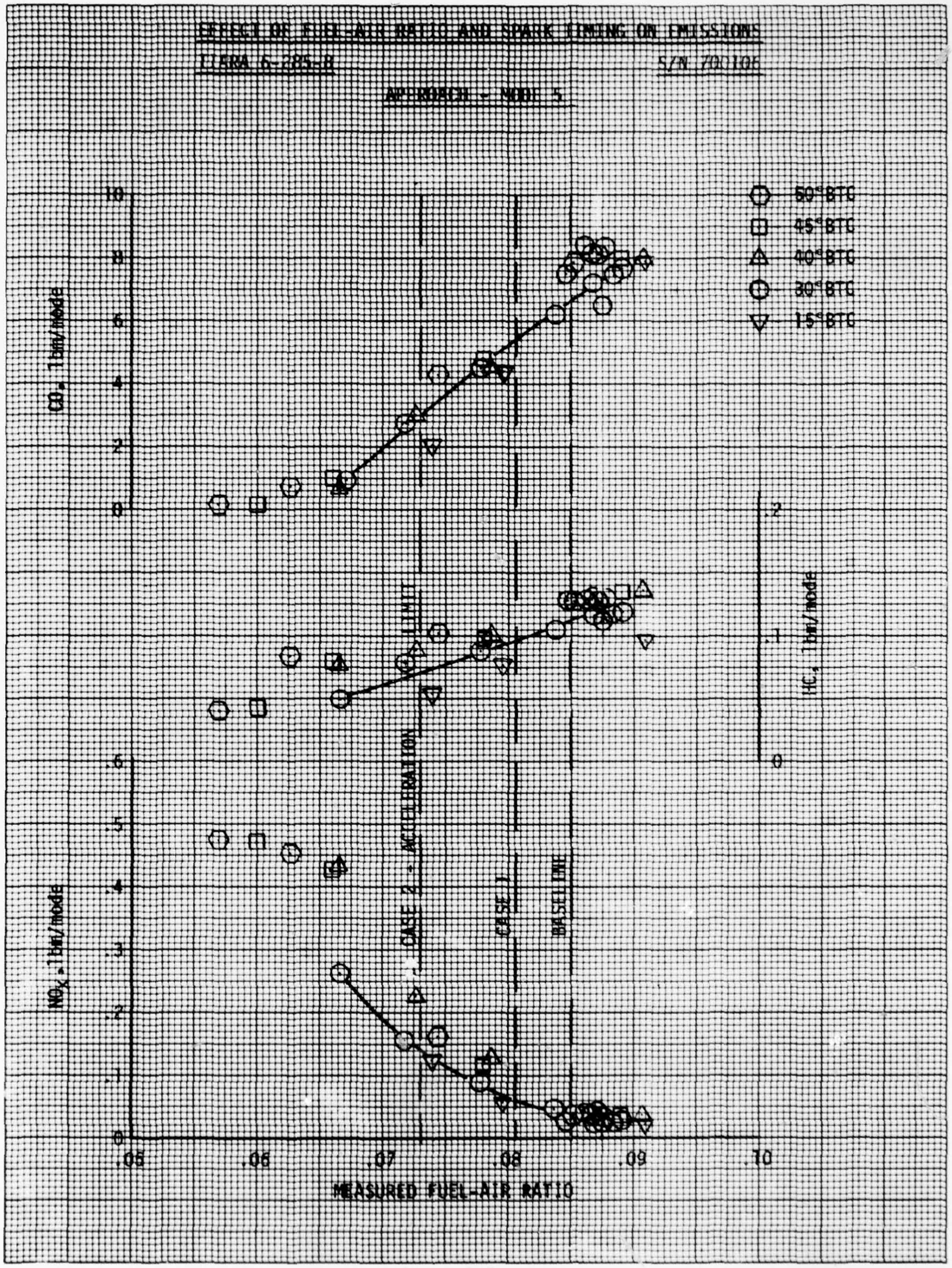


FIGURE 4.4-6
4.4-9

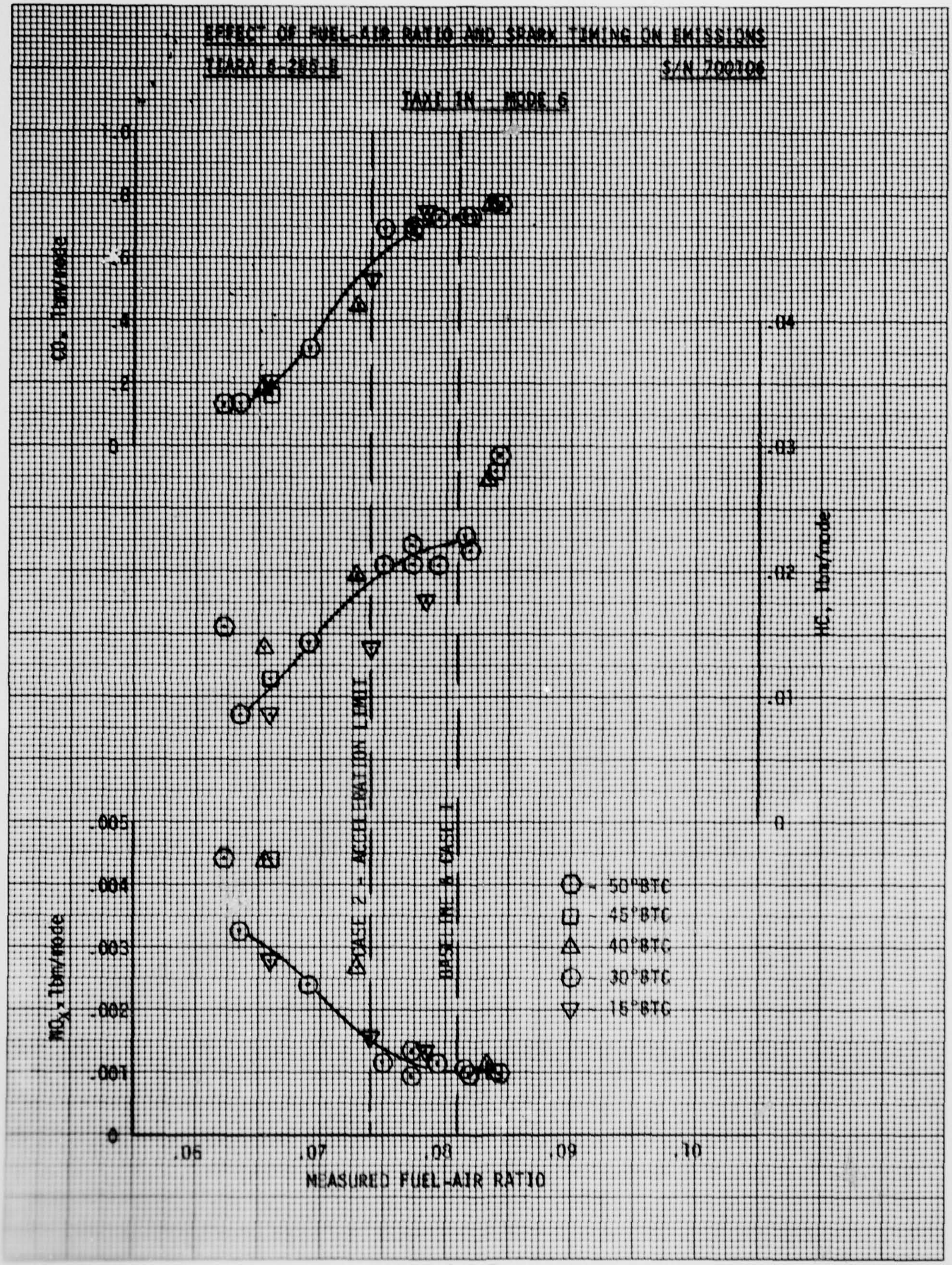

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
S/N 700706
TAXI IN - MODE 6
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
CASE 2 - ACCELERATION LIMIT
BASELINE & CASE 1
- 50°BTC
- 45°BTC
- 40°BTC
- 30°BTC
- 15°BTC
MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10

FIGURE 4.4-7

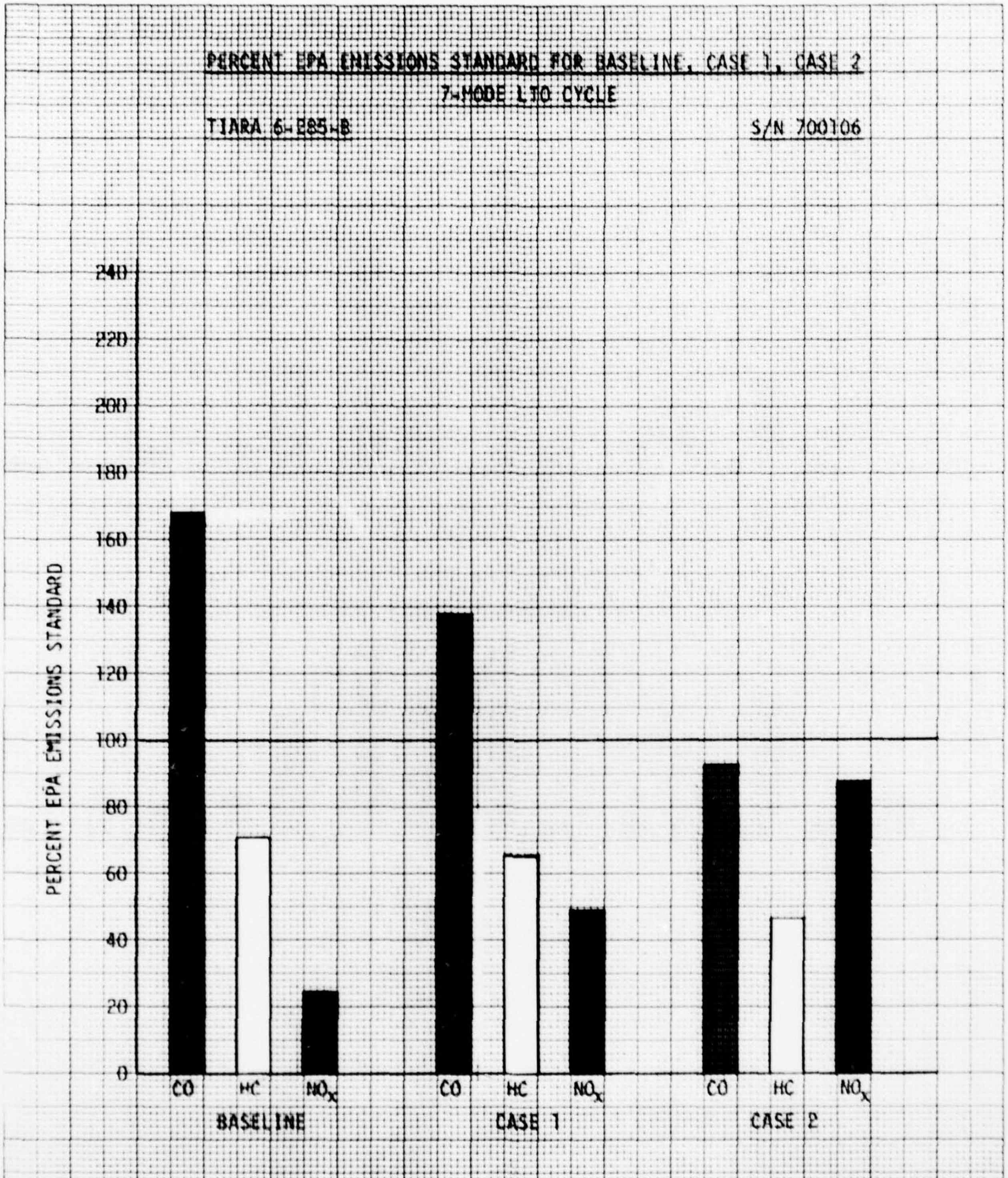
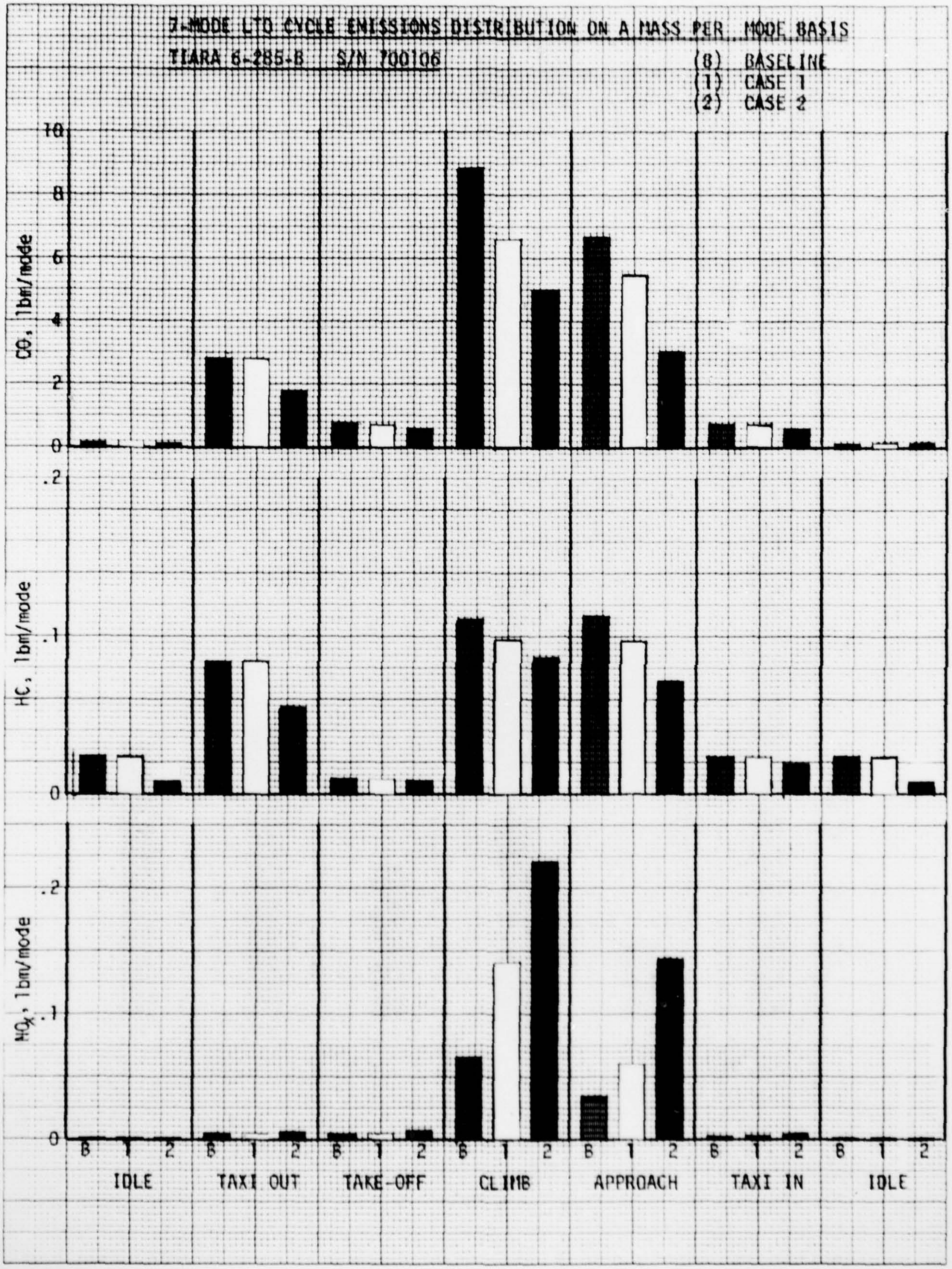

PERCENT EPA EMISSIONS STANDARD FOR BASELINE, CASE 1, CASE 2
7-MODE LTO CYCLE
TIARA 6-E85-B
S/N 700106
PERCENT EPA EMISSIONS STANDARD
240
220
200
180
160
140
120
100
80
60
40
20
0
CO
HC
NO$_x$
BASELINE
CO
HC
NO$_x$
CASE 1
CO
HC
NO$_x$
CASE 2

FIGURE 4.4-8



7-MODE LTO CYCLE EMISSIONS DISTRIBUTION ON A MASS PER MODE BASIS
TIARA 6-285-B S/N 700106
(B) BASELINE
(1) CASE 1
(2) CASE 2
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
10
8
6
4
2
0
.2
.1
0
.2
.1
0
B 1 2 B 1 2 B 1 2 B 1 2 B 1 2 B 1 2 B 1 2
IDLE
TAXI OUT
TAKE-OFF
CLIMB
APPROACH
TAXI IN
IDLE

FIGURE 4.4-9

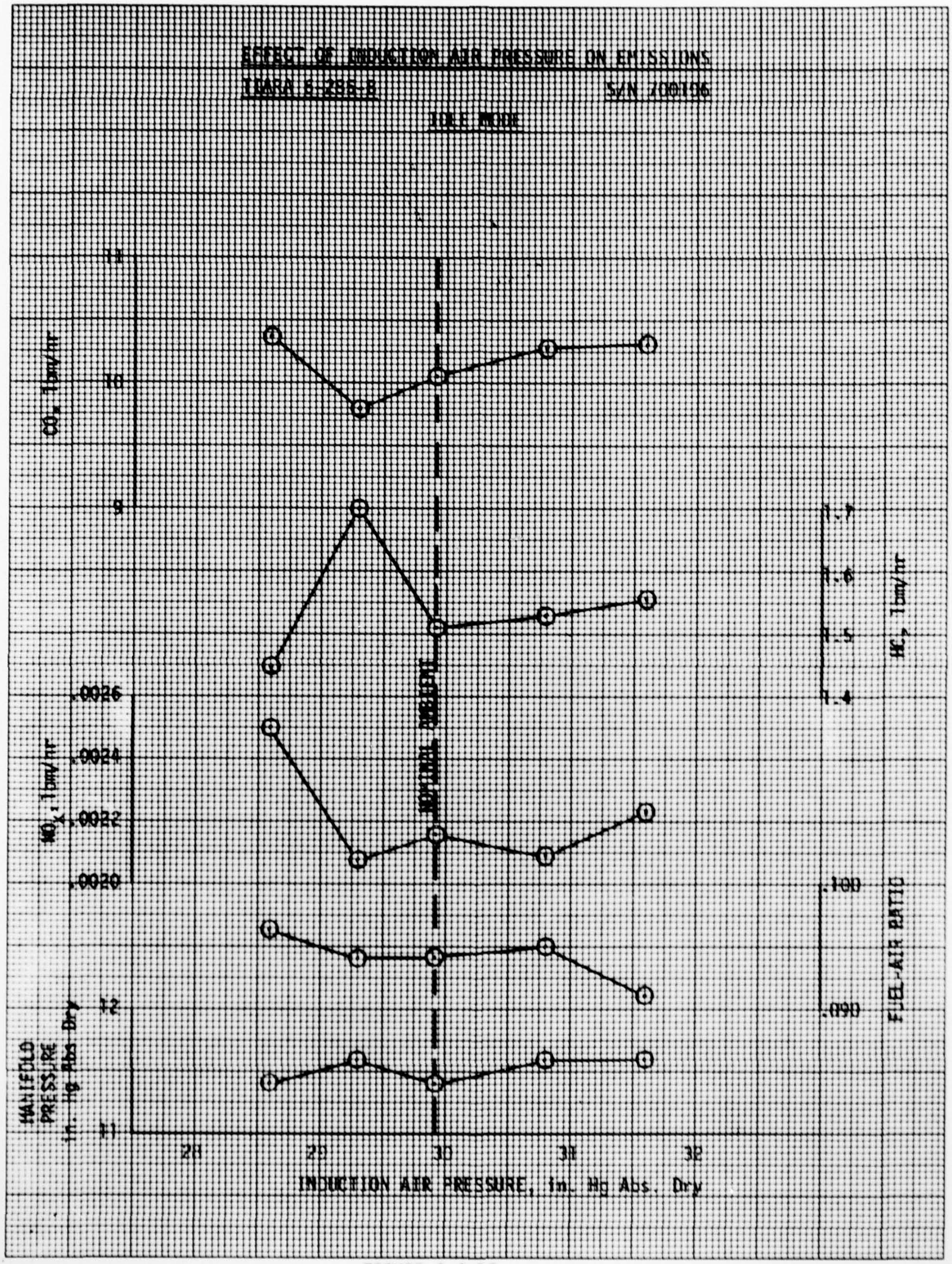

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TIARA 6-285-B
S/N 700106
IDLE MODE
CO, lbm/hr
HC, lbm/hr
NO_x, lbm/hr
FUEL-AIR RATIO
MANIFOLD PRESSURE in. Hg Abs Dry
NOMINAL AMBIENT
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.4-10

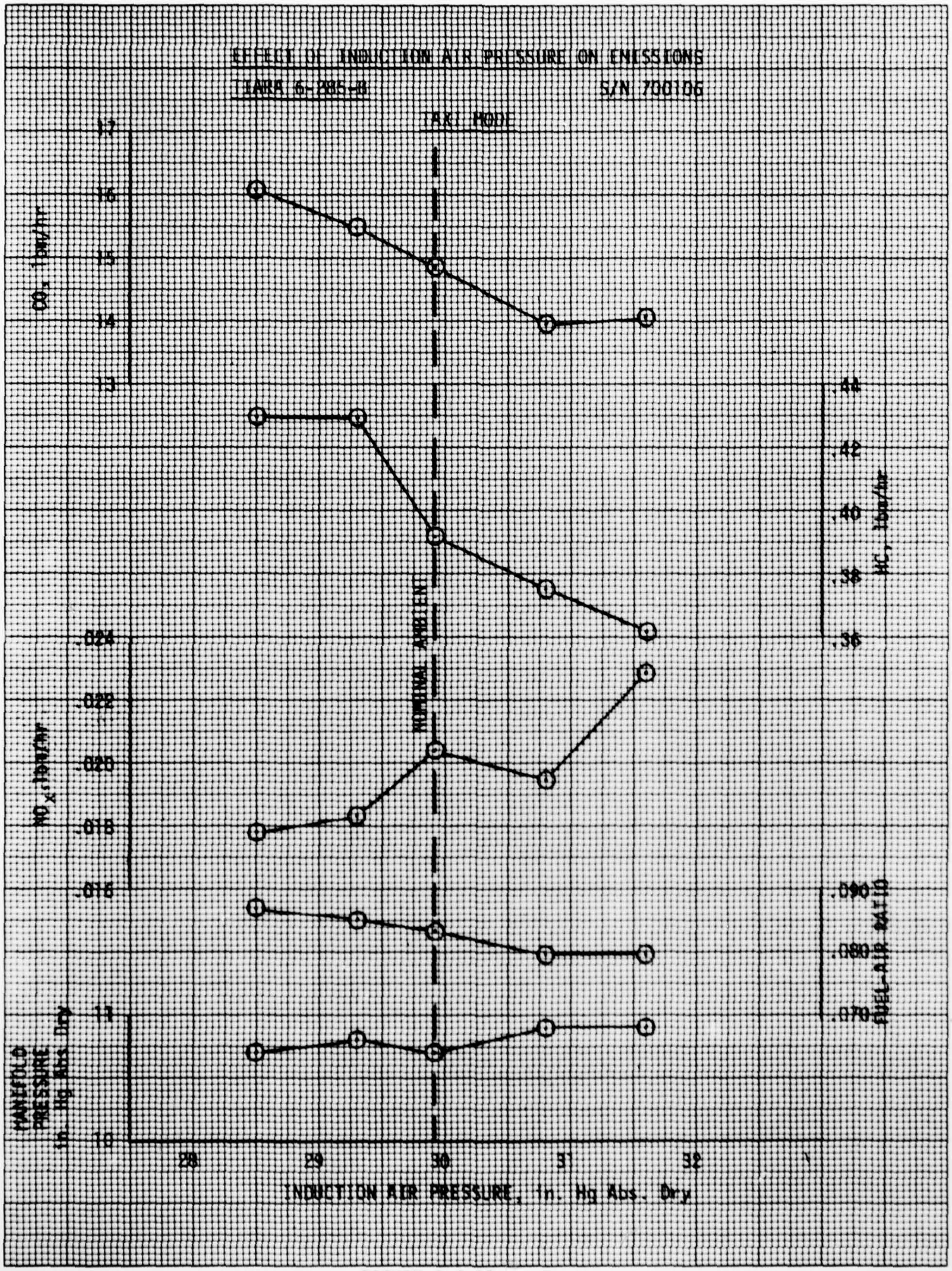

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TIARA 6-285-B
S/N 700106
TAXI MODE
NOMINAL AMBIENT
CO, lbm/hr
HC, lbm/hr
NO_x, lbm/hr
FUEL-AIR RATIO
MANIFOLD PRESSURE in. Hg Abs. Dry
INDUCTION AIR PRESSURE, in. Hg Abs. Dry
17
16
15
14
13
.44
.42
.40
.38
.36
.024
.022
.020
.018
.016
.090
.080
.070
11
10
28
29
30
31
32

FIGURE 4.4-11

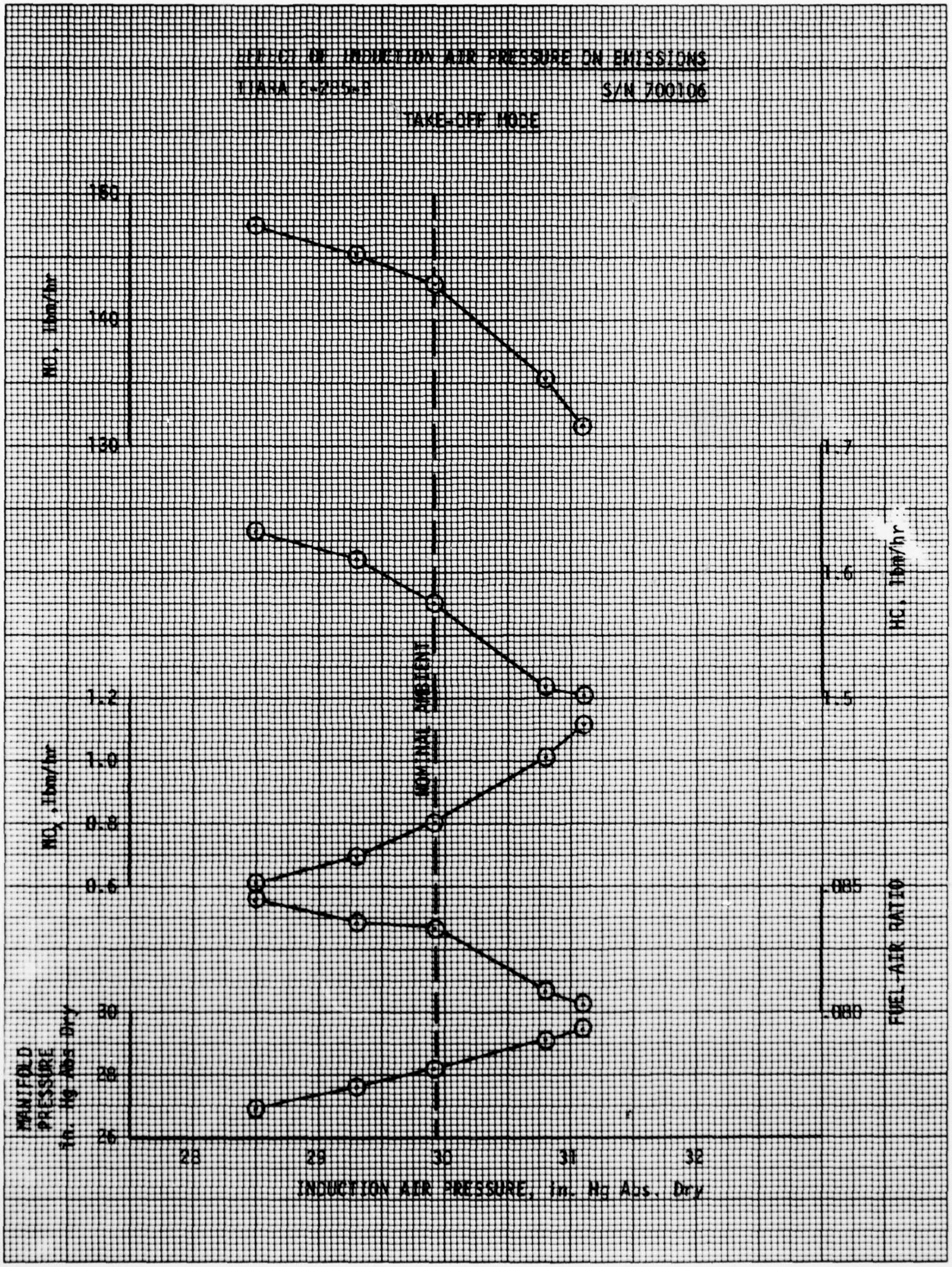

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TIARA 6-285-B
S/N 700106
TAKE-OFF MODE
HC, lbm/hr
NO$_x$, lbm/hr
MANIFOLD PRESSURE In. Hg Abs Dry
NOMINAL AMBIENT
FUEL-AIR RATIO
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.4-12

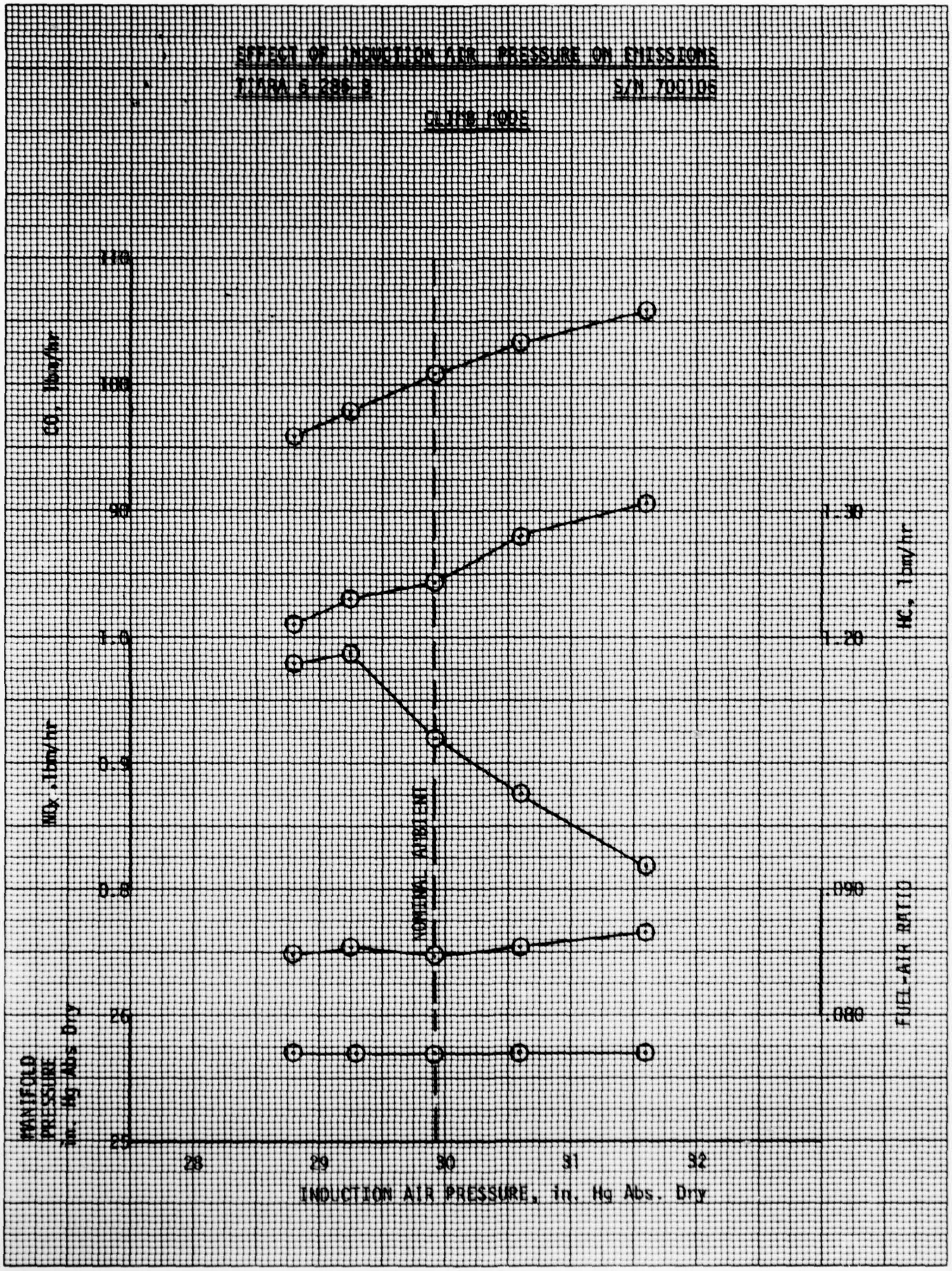

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TIARA 6-285-B
S/N 700106
CLIMB MODE
CO, lbm/hr
110
100
90
NOx, lbm/hr
1.0
0.9
0.8
MANIFOLD PRESSURE In. Hg Abs Dry
26
25
HC, lbm/hr
1.30
1.20
FUEL-AIR RATIO
.090
.080
NOMINAL AMBIENT
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.4-13

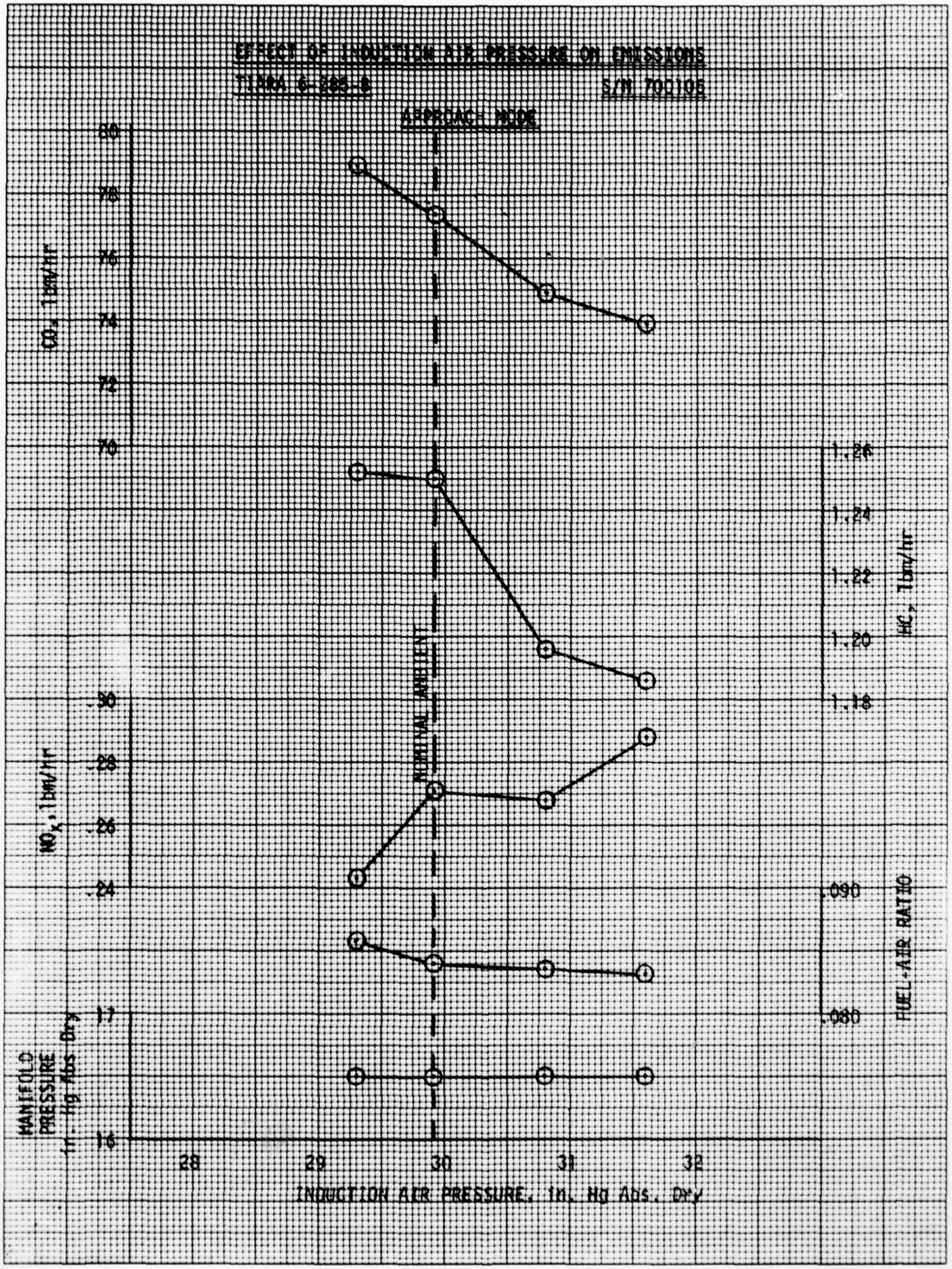
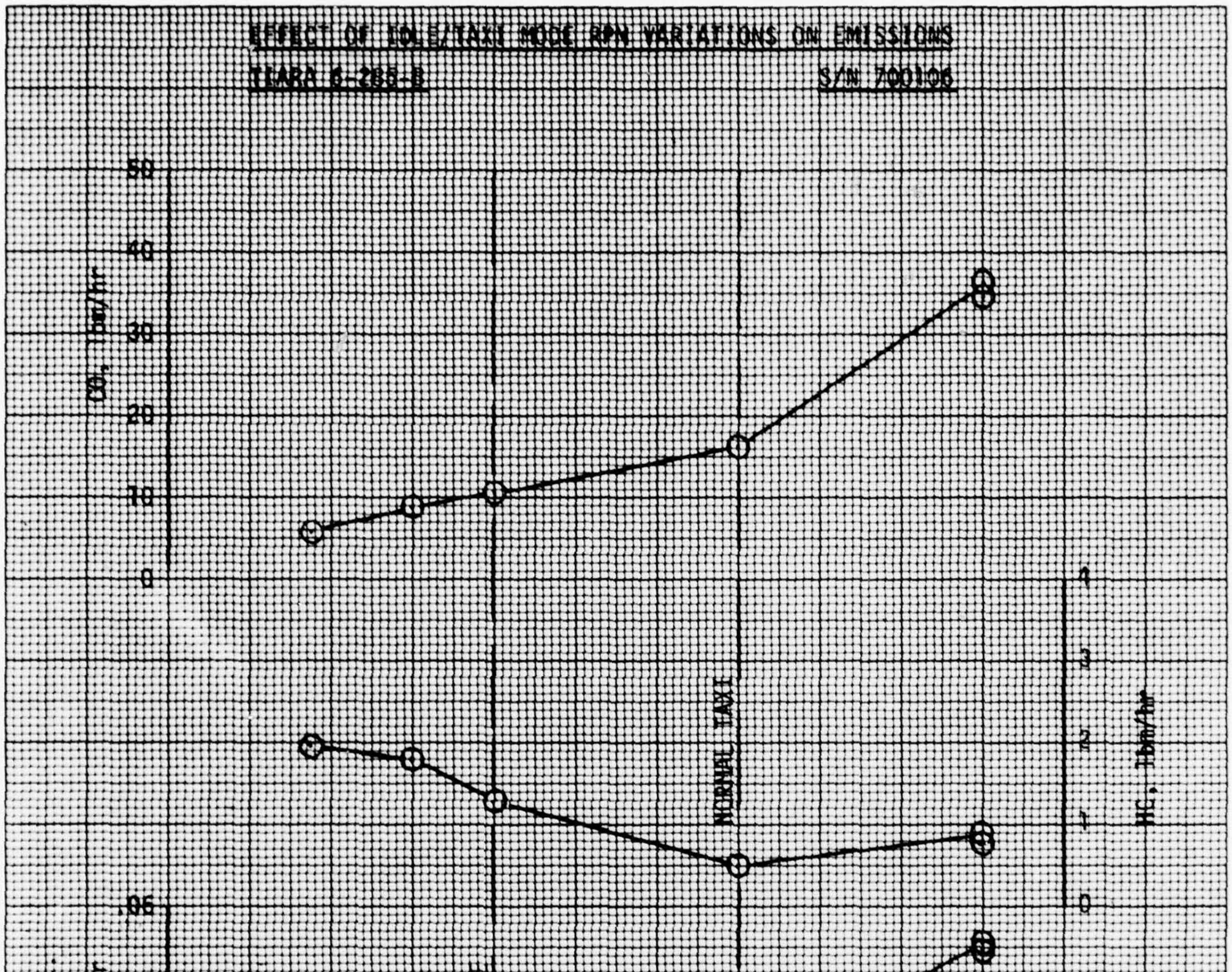

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
TIARA 6-285-B
S/N 700105
APPROACH MODE
NOMINAL AMBIENT
CO, lbm/hr
80
78
76
74
72
70
HC, lbm/hr
1.26
1.24
1.22
1.20
1.18
NO_x, lbm/hr
.30
.28
.26
.24
FUEL-AIR RATIO
.090
.080
MANIFOLD PRESSURE in. Hg Abs Dry
17
16
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.4-14



EFFECT OF IDLE/TAXI MODE RPM VARIATIONS ON EMISSIONS
TIARA 6-285-B
S/N 700106
CO, lbm/hr
HC, lbm/hr
NOx, lbm/hr
MANIFOLD PRESSURE
In. Hg Abs, dry
FUEL-AIR RATIO
NORMAL IDLE
NORMAL TAXI
PROPELLER SPEED, RPM

FIGURE 4.4-15

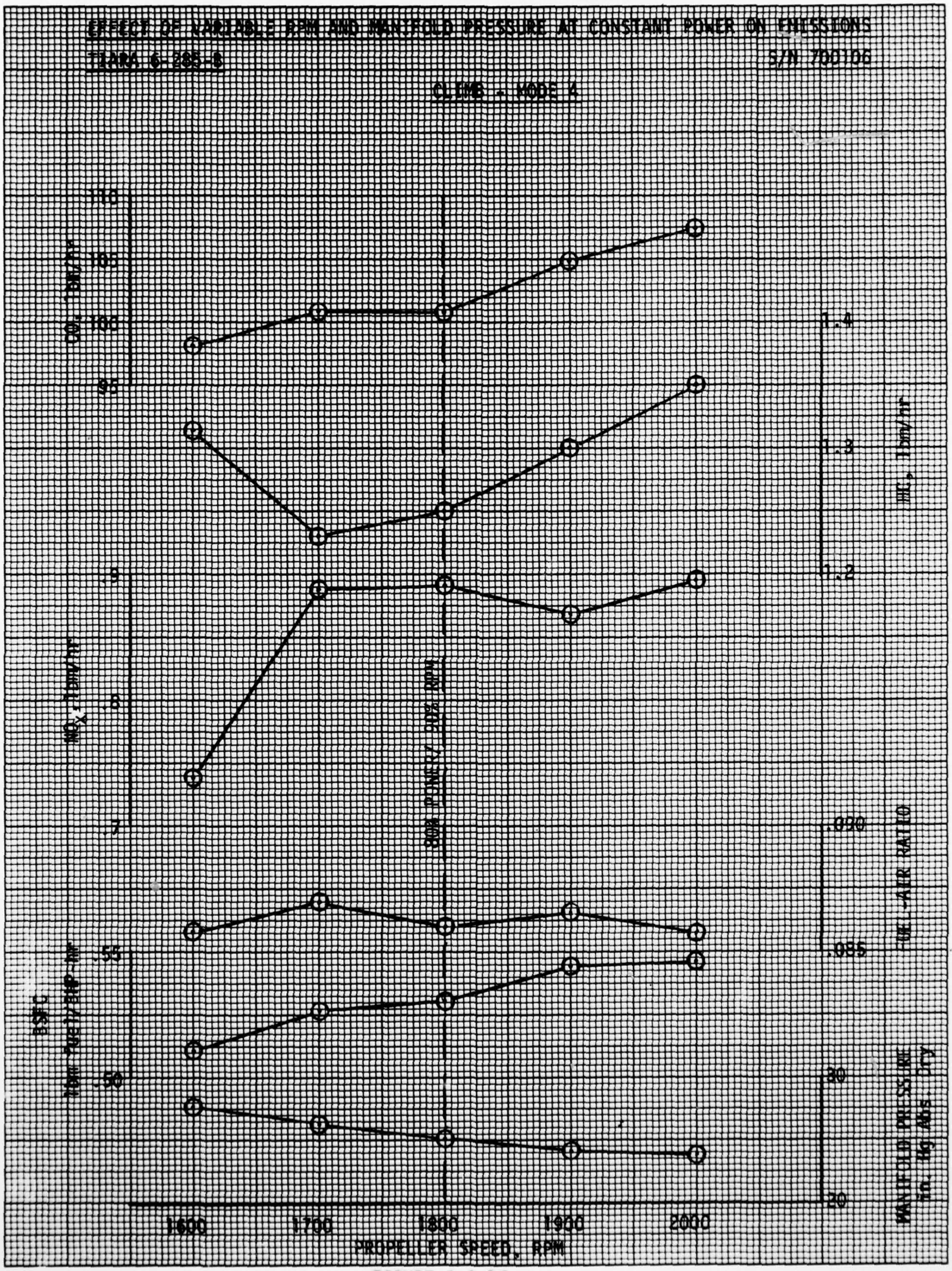
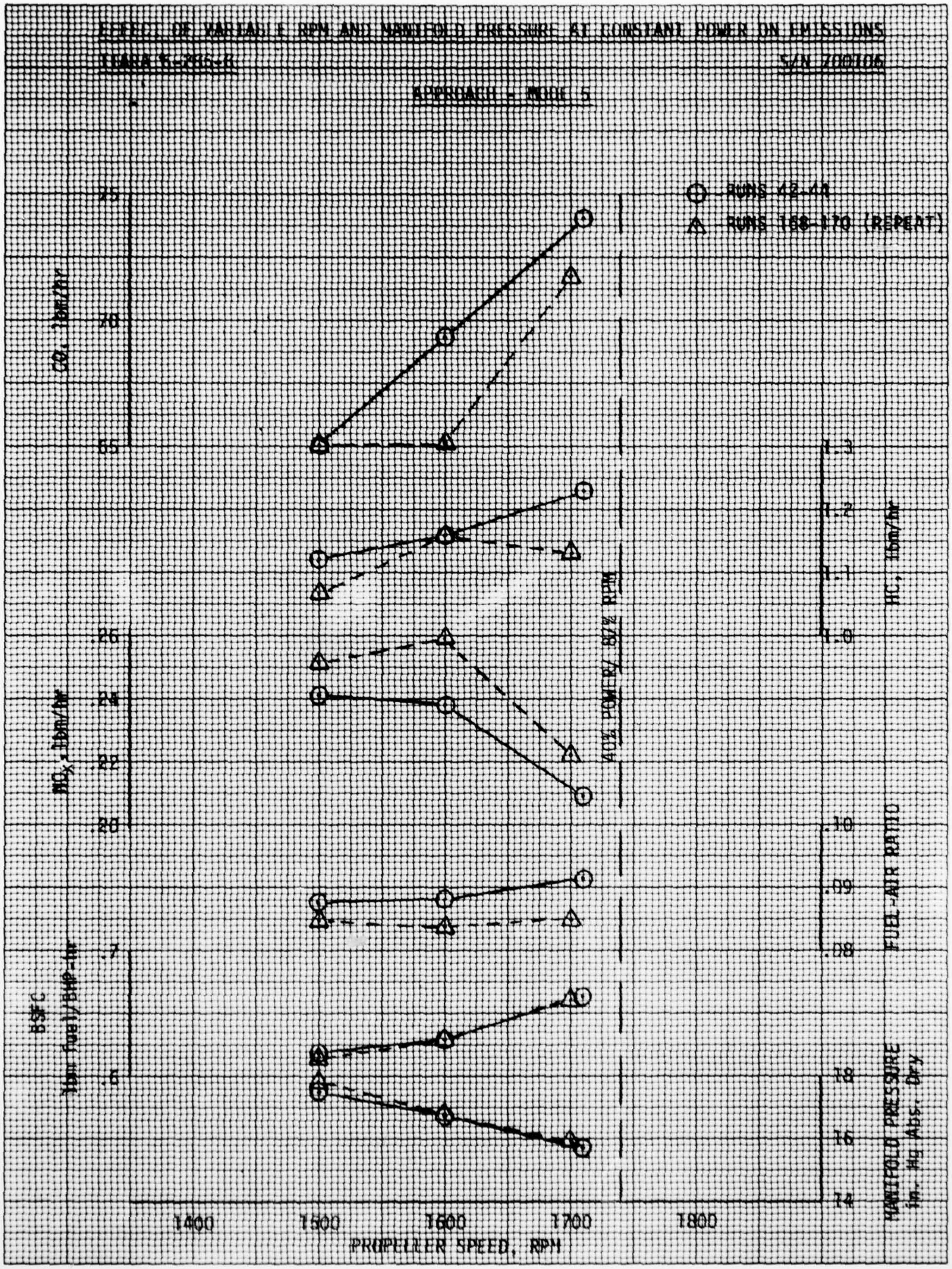

EFFECT OF VARIABLE RPM AND MANIFOLD PRESSURE AT CONSTANT POWER ON EMISSIONS
TIARA 6-285-B
S/N 700106
CLIMB - MODE 4
CO, lbm/hr
HC, lbm/hr
NO_x, lbm/hr
80% POWER/ 30% RPM
FUEL-AIR RATIO
BSFC lbm fuel/BHP-hr
MANIFOLD PRESSURE in. Hg Abs. Dry
PROPELLER SPEED, RPM
1600
1700
1800
1900
2000

FIGURE 4.4-16



EFFECT OF VARIABLE RPM AND MANIFOLD PRESSURE AT CONSTANT POWER ON EMISSIONS
TIARA 6-285-B
S/N 200106
APPROACH - MODE 5
RUNS 42-44
RUNS 168-170 (REPEAT)
CO, lbm/hr
NOx, lbm/hr
BSFC lbm fuel/BHP-hr
HC, lbm/hr
FUEL AIR RATIO
MANIFOLD PRESSURE in. Hg Abs. Dry
40% POWER/ 87% RPM
PROPELLER SPEED, RPM

FIGURE 4.4-17

4.5 GTSIO-520-K Exhaust Emissions Test Results

The GTSIO-520-K is the highest power, six-cylinder, aircraft piston engine in current production. Rated at 435 maximum continuous brake horsepower, the -K Model will maintain this power to its critical pressure altitude of 19,000 feet. The engine is designed with a sonic venturi for cabin pressurization and turbocharger compressor discharge air intercooler. The GTSIO-520-K uses the TCM continuous flow fuel injection system which responds to throttle angle, engine speed and turbocharger compressor discharge pressure.

The recommended fuel flow schedule is shown in Figure 4.5-1. BASELINE fuel flow is defined by the average of the rich and lean limits of full rich fuel flow. CASE 1 is at the lean limit above 75% power and at the minimum allowable fuel flow below 75% power.

Figures 4.5-2 thru 4.5-7 show the exhaust emissions for each mode of the 7-Mode LTO Cycle as a function of fuel-air ratio and spark timing. Lean operation at advanced spark timing was not explored in the Take-off Mode because of the possibility of detonation damage to the engine. Figure 4.5-4 shows the estimated detonation limit.

The CASE 2 limit (cylinder head temperature) is well above the detonation limit. In figure 4.5-6 for the Approach Mode, the extension of the lean misfire limit can be clearly seen for advanced spark timing.

The GTSIO-520-K has the lowest BASELINE hydrocarbons of the five engines tested. The CO values are relatively high as can be seen from Figure 4.5-8. Even when leaned to CASE 2 fuel flows, the engine was not able to meet the EPA Standards for carbon monoxide. The distribution of emissions over the 7-Mode LTO Cycle is shown in Figure 4.5-9. The largest contributor to NO_x emissions is the Approach Mode, while Climb and Taxi Out produce the bulk of the HC emissions. The CO emissions are generated mainly by the Climb Mode.

Variations in induction air pressure and their effect on emissions are shown in Figures 4.5-10 thru 4.5-14. Note that in the higher power modes the effects are similar. An increase in induction air pressure gives a general decrease in CO and HC while NO_x increases.

Constant power operation while varying RPM and manifold pressure at 80% and 40% power (Figures 4.5-15, 4.5-16) follows the trend of change in fuel-air ratio. The limitation of speed range at 40% power is due to the propeller governor control limit.

TABLE 4.5-1

GTSIO-520-K ENGINE DESCRIPTION

TYPE CERTIFICATE NUMBER	E7CE
DATE OF ISSUANCE	7/31/74
NUMBER OF CYLINDERS	6
CUBIC INCH DISPLACEMENT	519.54
CYLINDER BORE (inches)	5.25
PISTON STROKE (inches)	4.00
COMPRESSION RATIO	7.5:1
DRIVE RATIO (propeller/crankshaft)	0.67:1
AIR INDUCTION SYSTEM	TURBOCHARGED
FUEL CONTROL SYSTEM	FUEL INJECTED
RATED MAXIMUM TAKE-OFF POWER	435 BHP
RATED MAXIMUM TAKE-OFF PROPELLER RPM	2267 RPM
RATED MAXIMUM CONTINUOUS POWER	435 BHP
RATED MAXIMUM CONTINUOUS PROPELLER RPM	2267 RPM
MAXIMUM ALLOWABLE CYLINDER HEAD TEMPERATURE	460°F
MAXIMUM ALLOWABLE EXHAUST GAS TEMPERATURE	1650°F
MINIMUM FUEL OCTANE RATING	100/130 Avgas
IGNITION TIMING (degrees btc)	20°

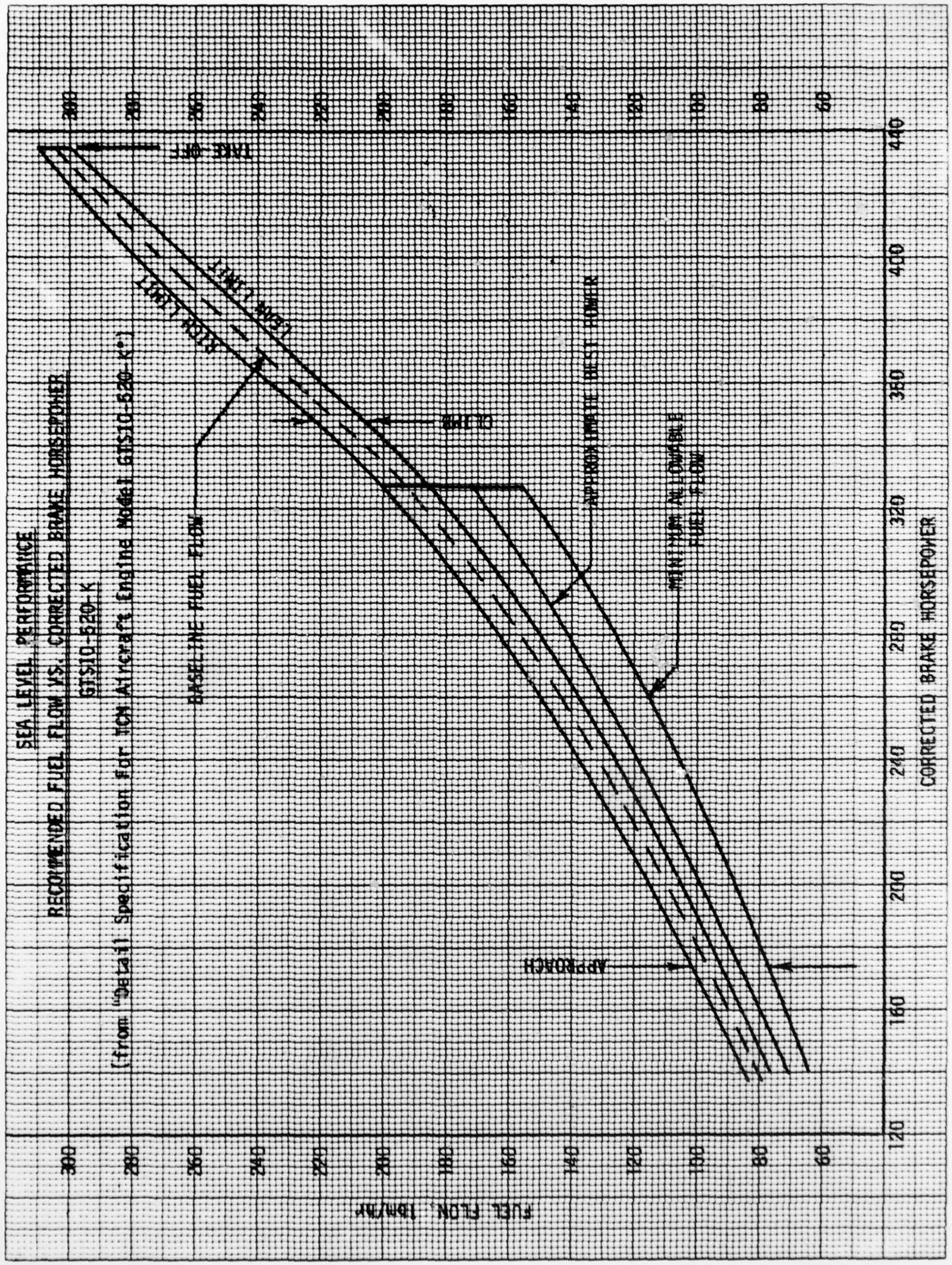
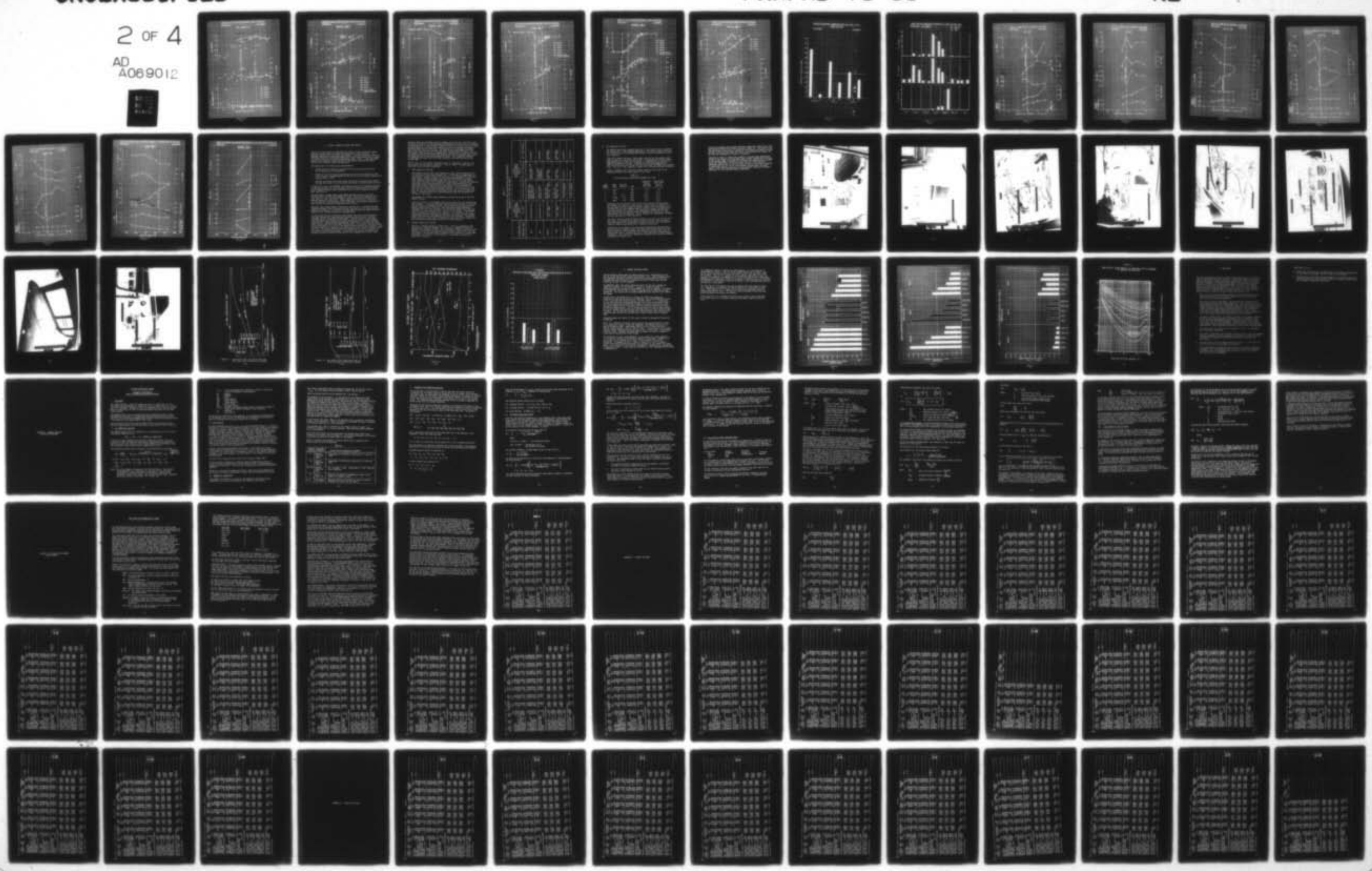
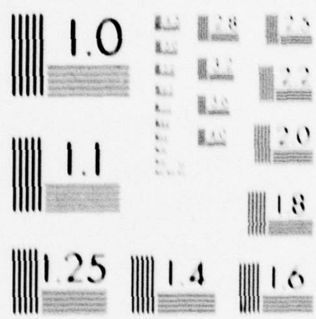

SEA LEVEL PERFORMANCE
RECOMMENDED FUEL FLOW VS. CORRECTED BRAKE HORSEPOWER
GTSIO-520-K
(from "Detail Specification for TCM Aircraft Engine Model GTSIO-520-K")
BASELINE FUEL FLOW
RICH LIMIT
LEAN LIMIT
TAKE OFF
CLIMB
APPROXIMATE BEST POWER
MINIMUM ALLOWABLE FUEL FLOW
APPROACH
FUEL FLOW, lbs/hr
CORRECTED BRAKE HORSEPOWER
120
160
200
240
280
320
360
400
440
60
80
100
120
140
160
180
200
220
240
260
280
300

FIGURE 4.5-1

AD-A069 012 TELEDYNE CONTINENTAL MOTORS MOBILE AL AIRCRAFT PRODU--ETC F/G 21/7
EXHAUST EMISSIONS CHARACTERISTICS OF FIVE AIRCRAFT PISTON ENGIN--ETC(U)
MAR 79 K J STUCKAS DOT-FA74NA-1091
UNCLASSIFIED FAA/RD-78-88 NL

2 OF 4
AD
A069012





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

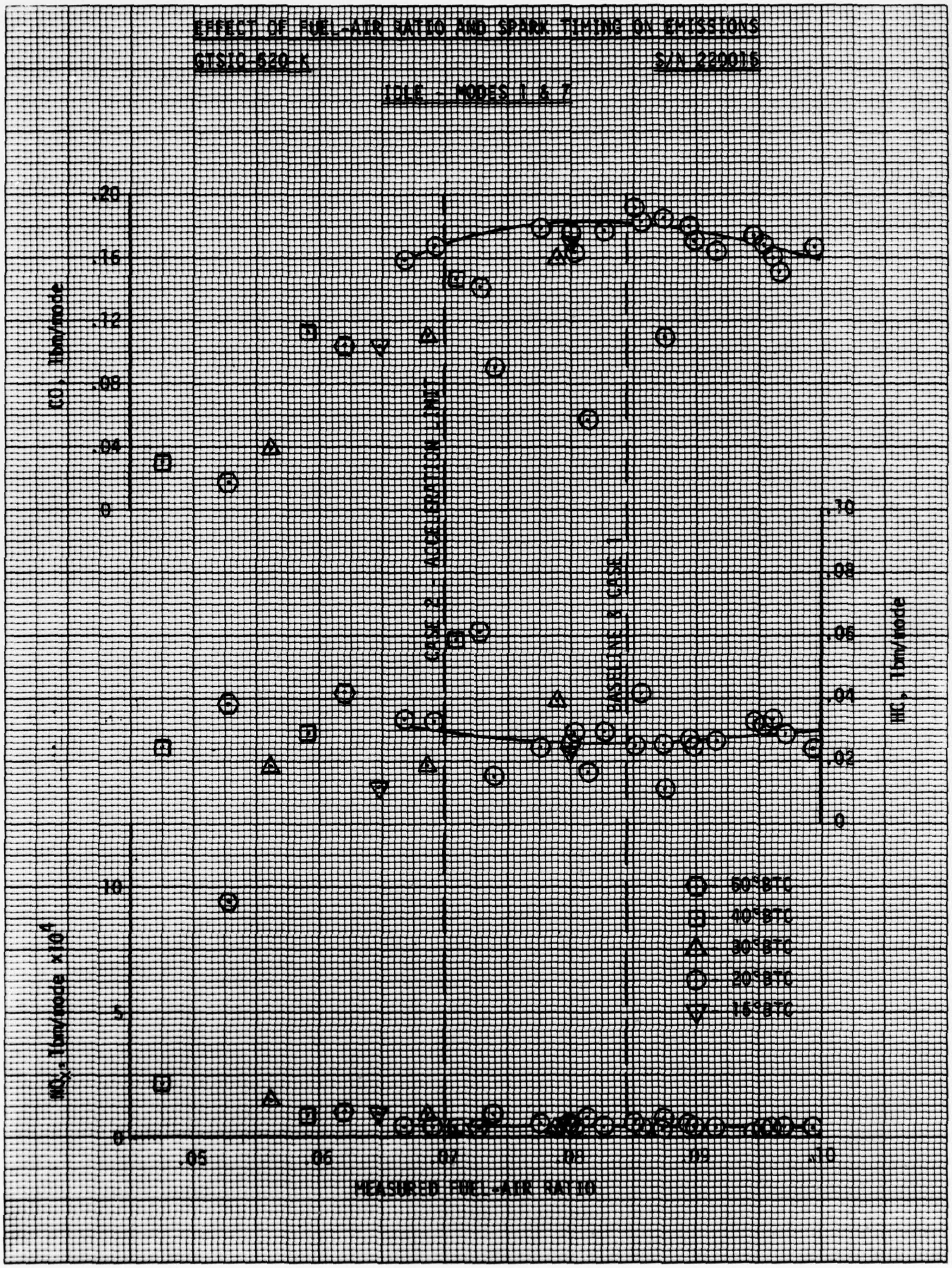

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
GTSIO-520-K
S/N 220016
IDLE - MODES 1 & 7
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode x10^4
CASE 2 - ACCELERATION LIMIT
BASELINE & CASE 1
60°BTC
40°BTC
30°BTC
20°BTC
16°BTC
MEASURED FUEL-AIR RATIO

FIGURE 4.5-2

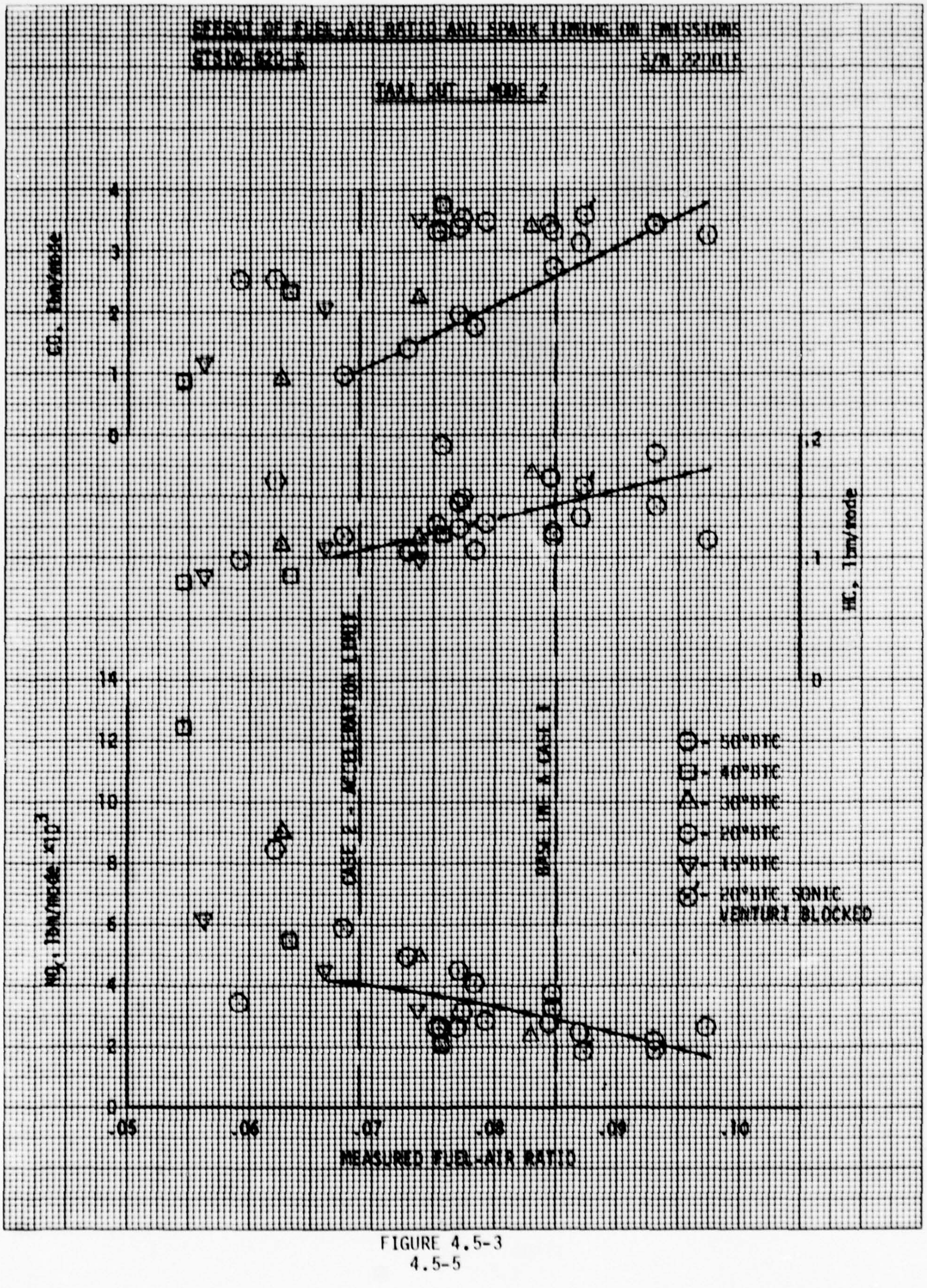

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
GTSIO-520-K
S/N 221015
TAXI OUT - MODE 2
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode x10^3
CASE 2 - ACCELERATION LIMIT
BASELINE & CASE 1
50°BTC
40°BTC
30°BTC
20°BTC
15°BTC
20°BTC SONIC VENTURI BLOCKED
MEASURED FUEL-AIR RATIO
.05
.06
.07
.08
.09
.10

FIGURE 4.5-3

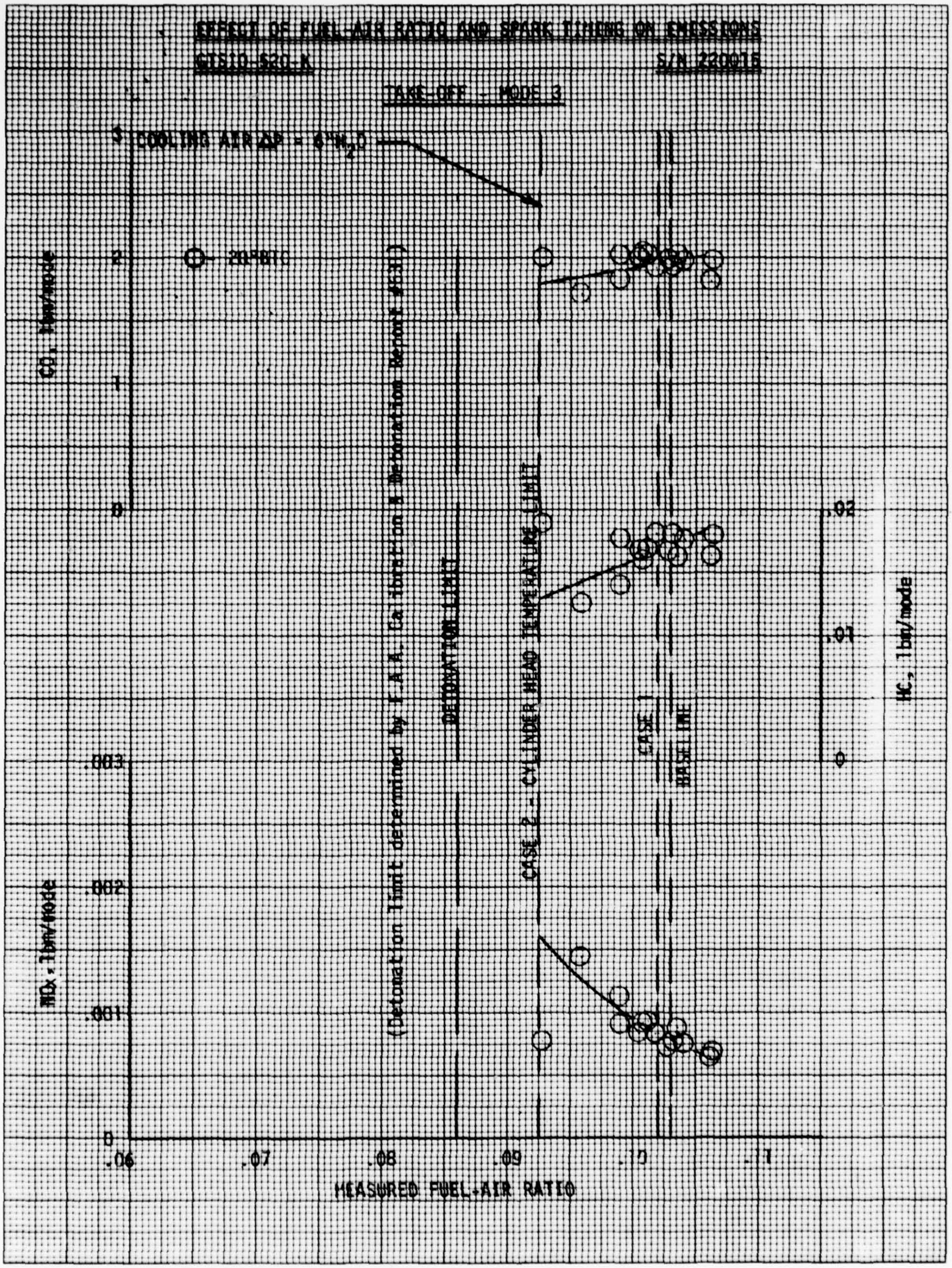

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
GTSIO-520-K
S/N 220015
TAKE-OFF - MODE 3
COOLING AIR ΔP - 4"H2O
20°BTC
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
(Detonation limit determined by F.A.A. Calibration & Detonation Report #C31)
DETONATION LIMIT
CASE 2 - CYLINDER HEAD TEMPERATURE LIMIT
CASE 1
BASELINE
MEASURED FUEL-AIR RATIO
.06
.07
.08
.09
.10
.11

FIGURE 4.5-4

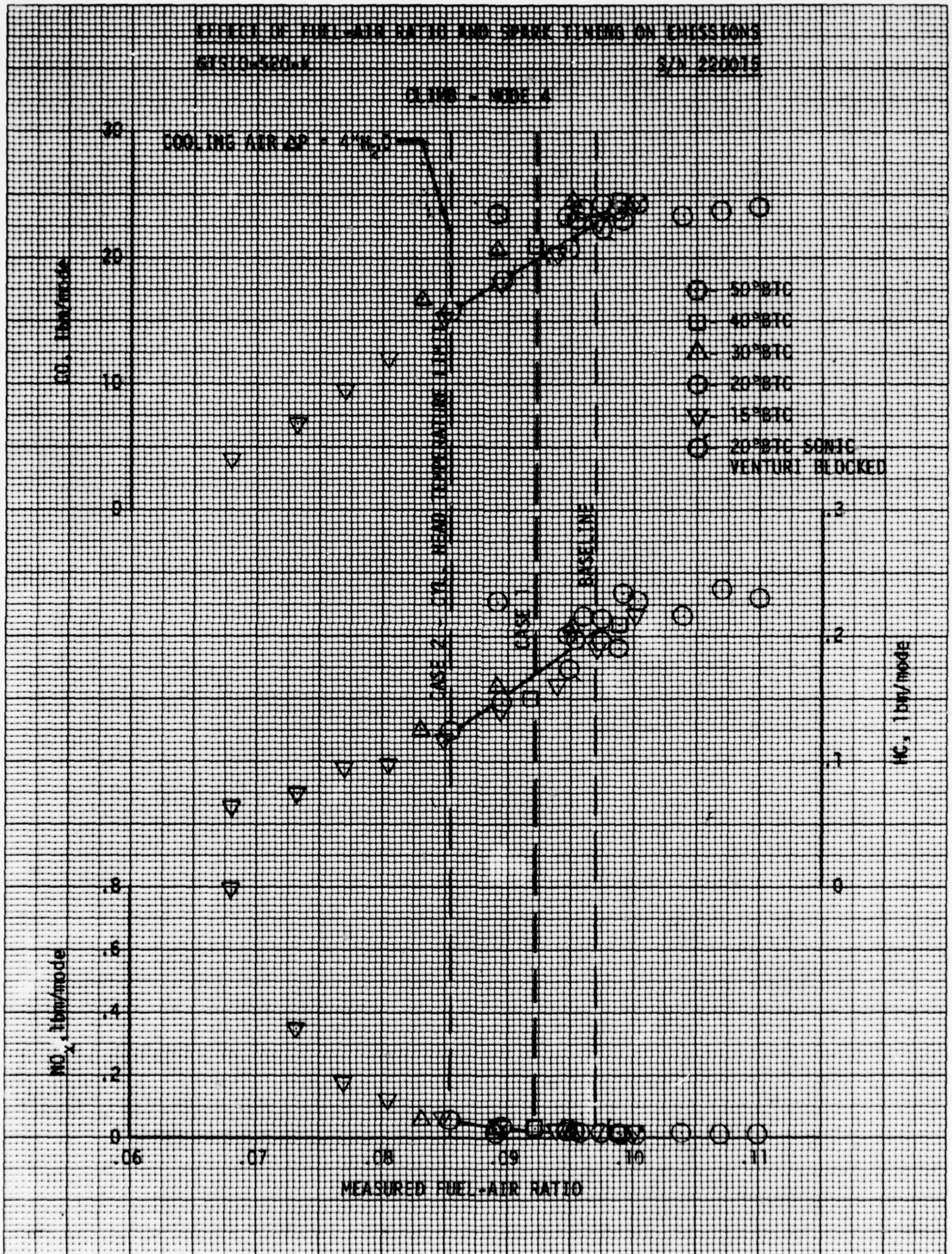

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
GTSIO-520-K
S/N 220015
CLIMB - MODE 4
COOLING AIR ΔP = 4"H2O
CO, lbm/mode
HC, lbm/mode
NOx, lbm/mode
CASE 2 CYL. HEAD TEMPERATURE LIMIT
CASE 1
BASELINE
50°BTC
40°BTC
30°BTC
20°BTC
15°BTC
20°BTC SONIC VENTURI BLOCKED
MEASURED FUEL-AIR RATIO

FIGURE 4.5-5

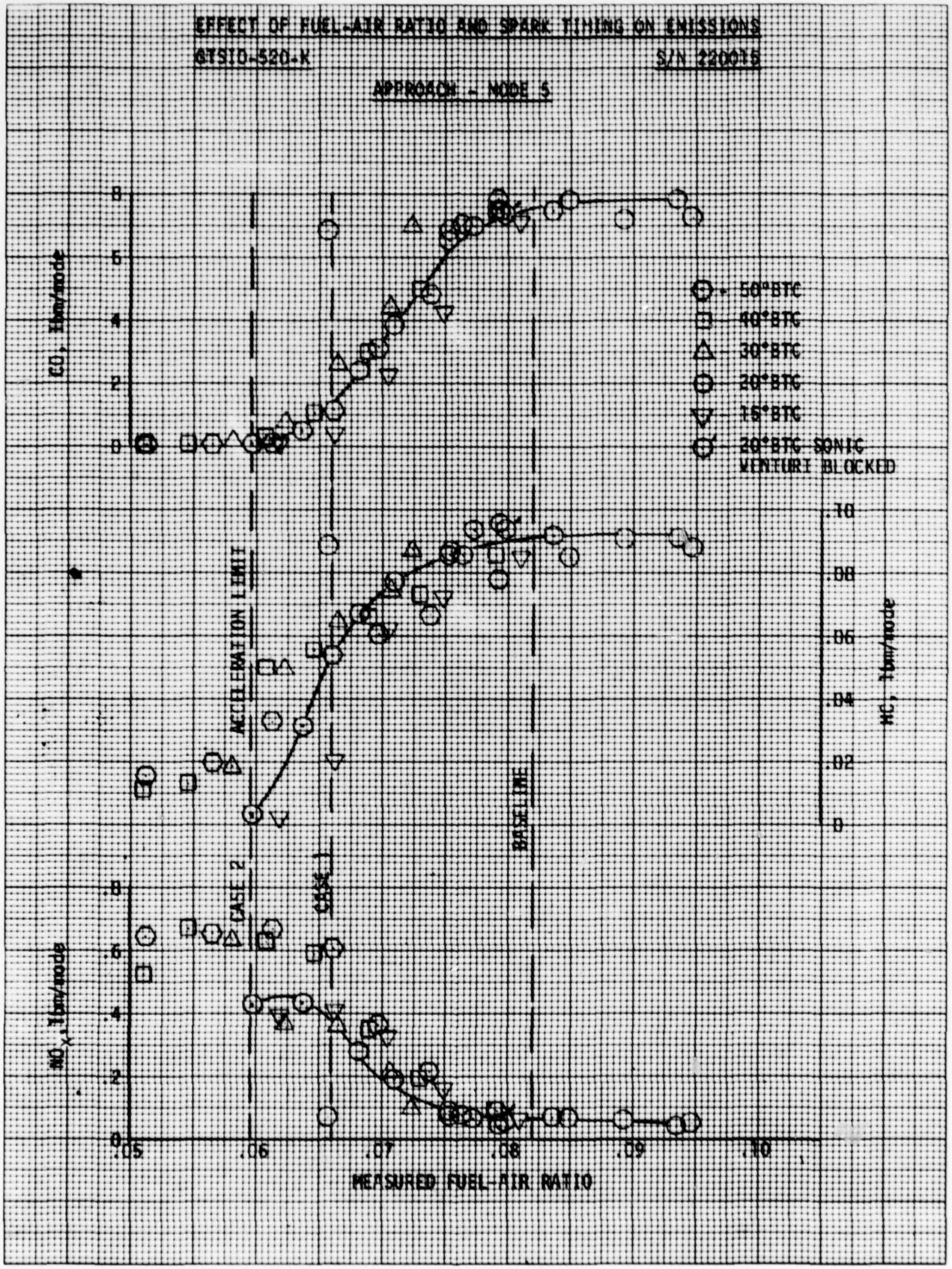

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
GTSIO-520-K
S/N 220015
APPROACH - MODE 5
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode
50°BTC
40°BTC
30°BTC
20°BTC
15°BTC
20°BTC SONIC VENTURI BLOCKED
ACCELERATION LIMIT
CASE 2
CASE 1
BASELINE
MEASURED FUEL-AIR RATIO

FIGURE 4.5-6

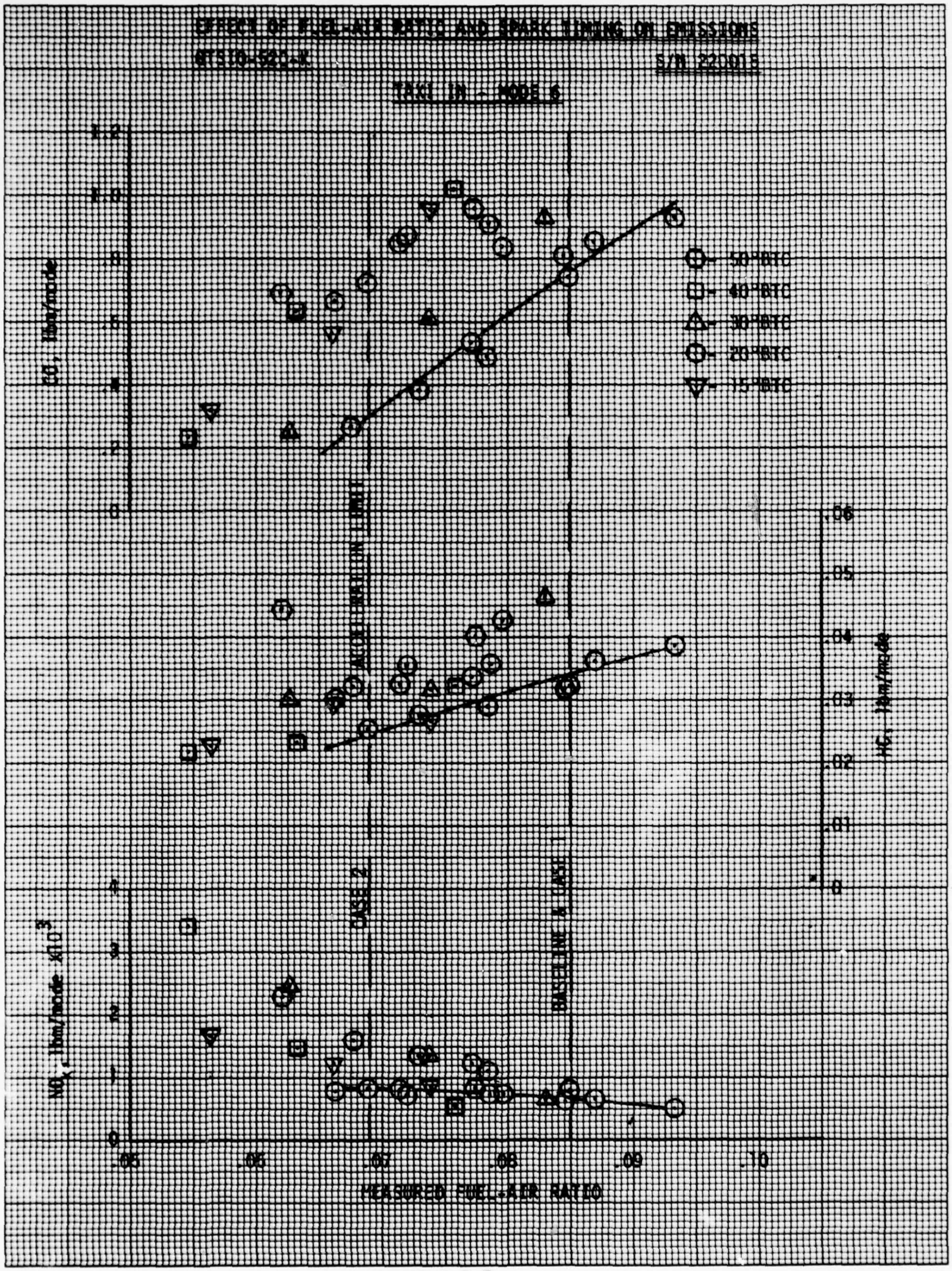

EFFECT OF FUEL-AIR RATIO AND SPARK TIMING ON EMISSIONS
GTSIO-520-K
S/N 220015
TAXI IN - MODE 6
CO, lbm/mode
HC, lbm/mode
NO_x, lbm/mode X10^3
MEASURED FUEL-AIR RATIO
50°BTC
40°BTC
30°BTC
20°BTC
15°BTC
ACCELERATION LIMIT
CASE 2
BASELINE & CASE

FIGURE 4.5-7

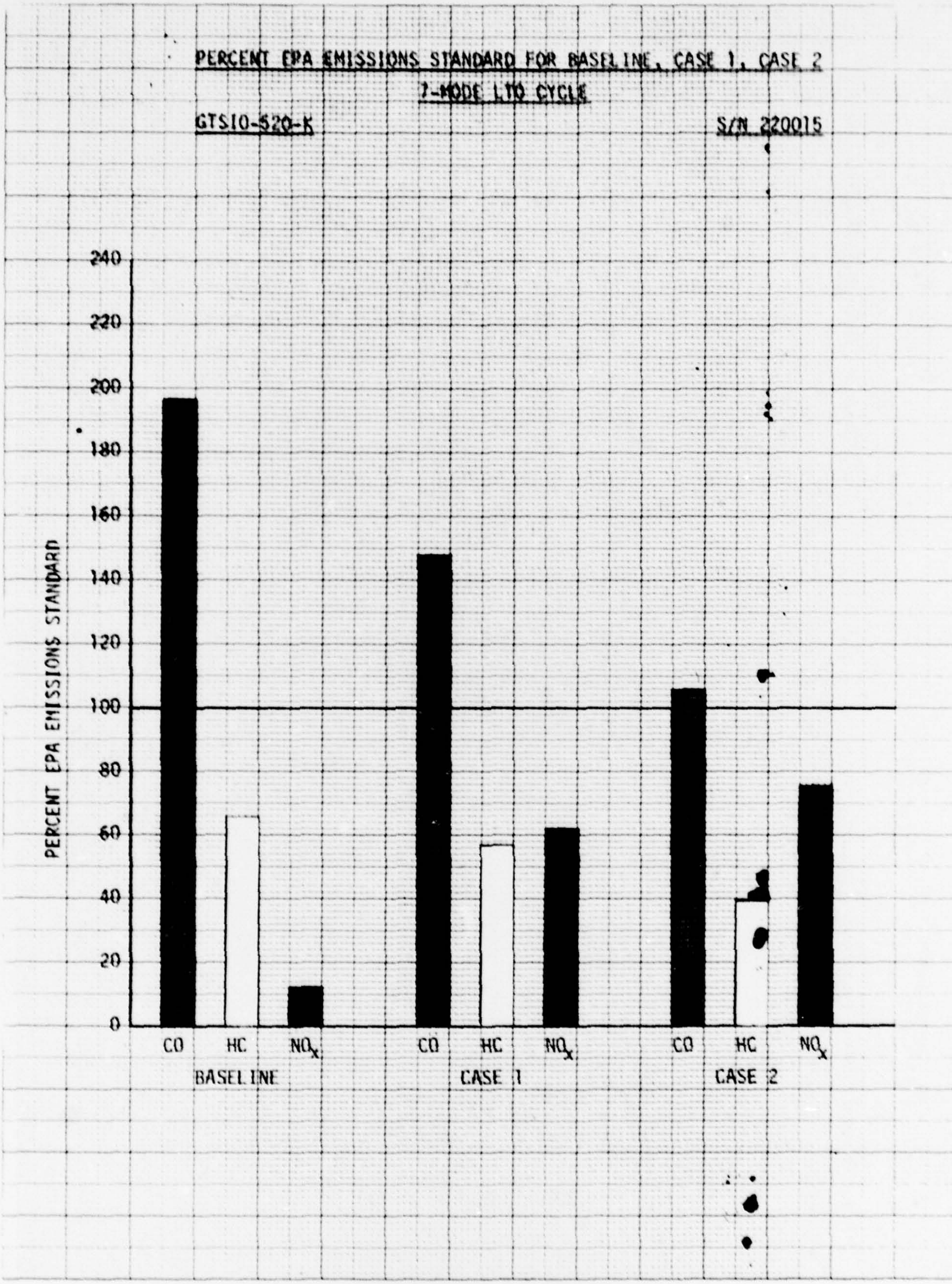
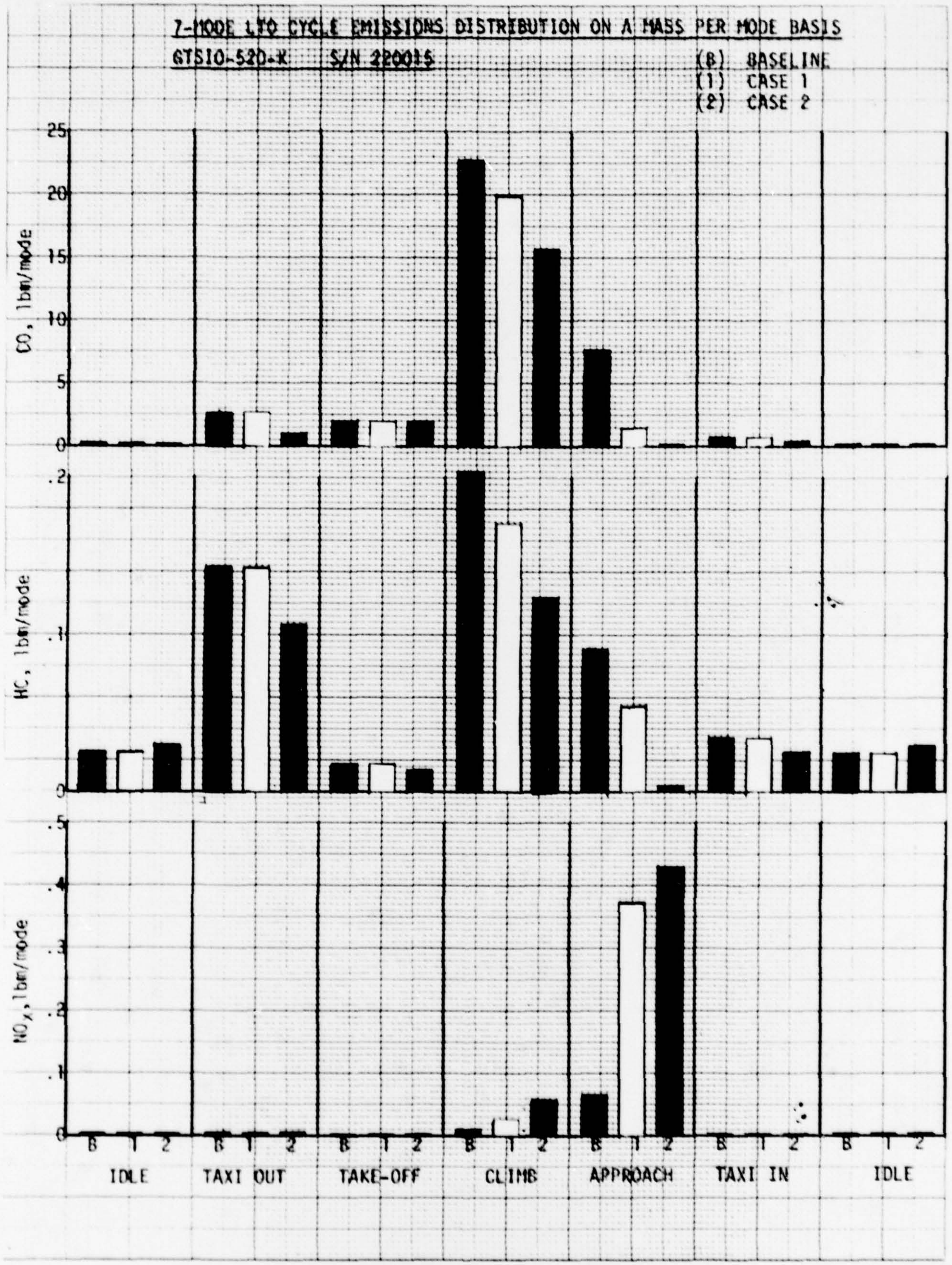

PERCENT EPA EMISSIONS STANDARD FOR BASELINE, CASE 1, CASE 2
7-MODE LTO CYCLE
GTSIO-520-K
S/N 220015
PERCENT EPA EMISSIONS STANDARD
240
220
200
180
160
140
120
100
80
60
40
20
0
CO
HC
NO_x
BASELINE
CO
HC
NO_x
CASE 1
CO
HC
NO_x
CASE 2

FIGURE 4.5-8



7-MODE LTO CYCLE EMISSIONS DISTRIBUTION ON A MASS PER MODE BASIS
GTSIO-520-K S/N 220015
(B) BASELINE
(1) CASE 1
(2) CASE 2
CO, lbm/mode
25
20
15
10
5
0
HC, lbm/mode
.2
.1
0
NO_x, lbm/mode
.5
.4
.3
.2
.1
0
B 1 2
IDLE
TAXI OUT
TAKE-OFF
CLIMB
APPROACH
TAXI IN
IDLE

FIGURE 4.5-9

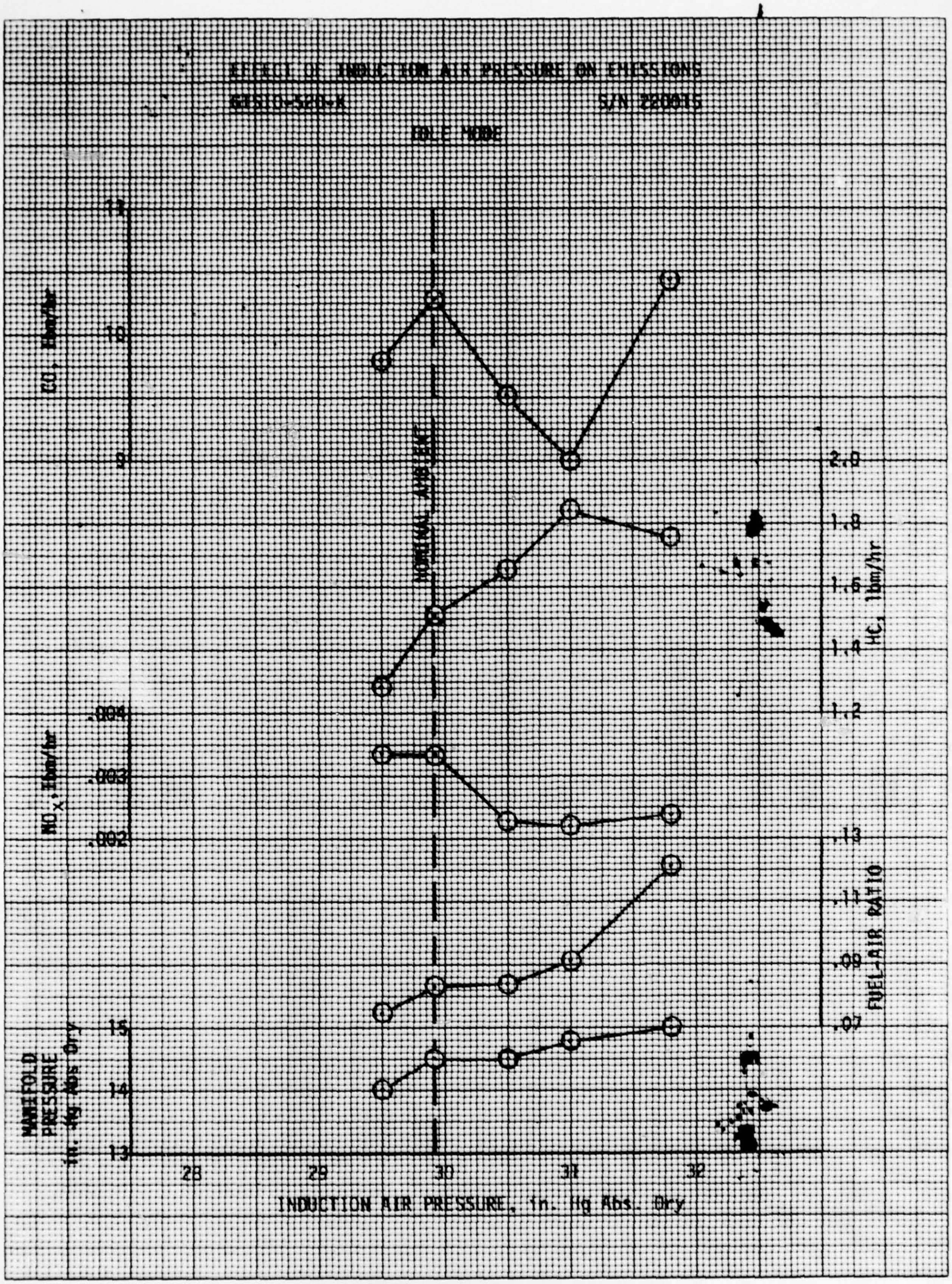

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
GTSIO-520-K
S/N 220015
IDLE MODE
CO, lbm/hr
NOMINAL AMBIENT
HC, lbm/hr
NO_X, lbm/hr
FUEL-AIR RATIO
MANIFOLD PRESSURE in. Hg Abs Dry
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.5-10

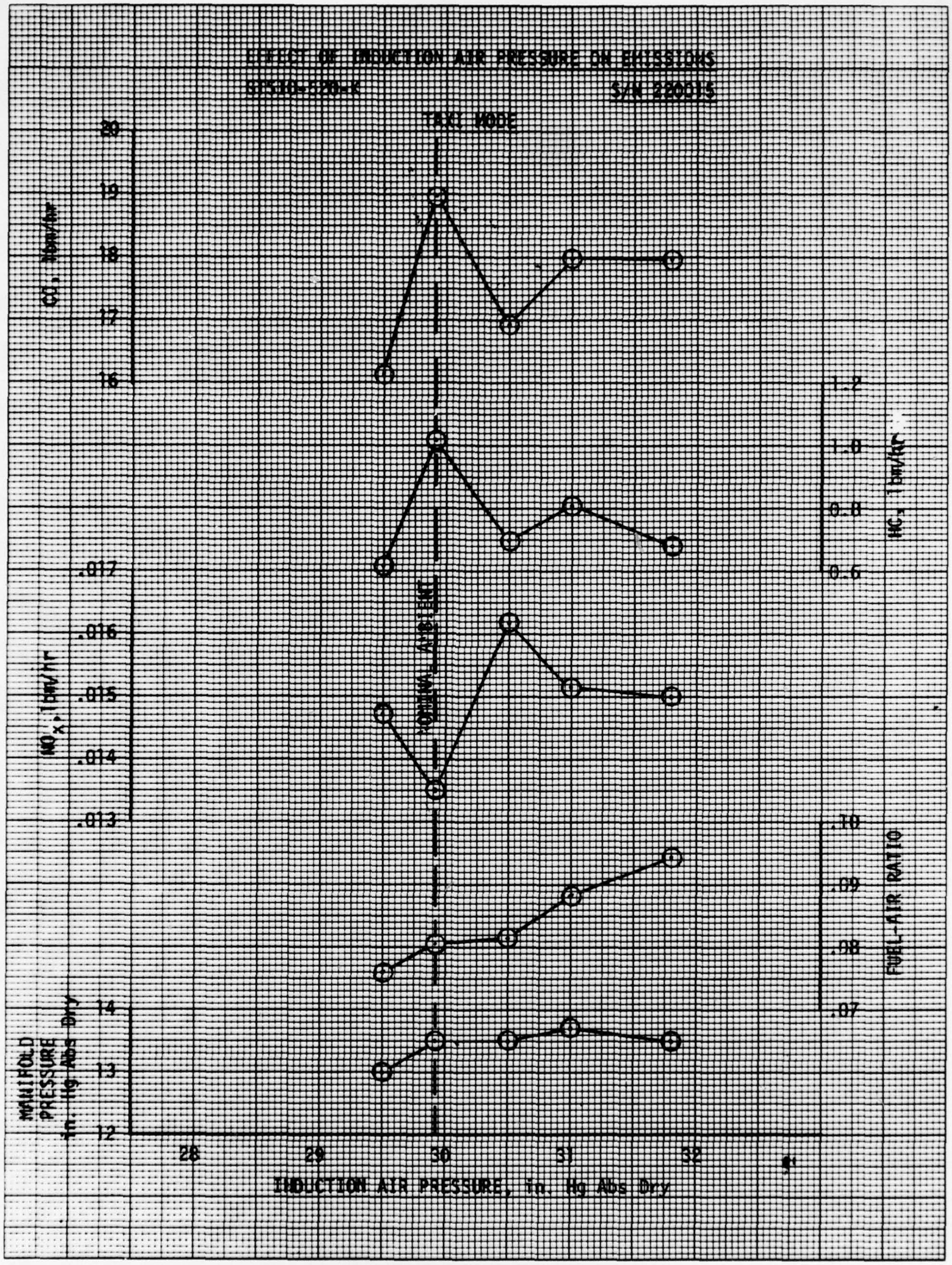

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
GTSIO-520-K
S/N 220015
TAXI MODE
CO, lbm/hr
HC, lbm/hr
NO_x, lbm/hr
FUEL-AIR RATIO
MANIFOLD PRESSURE in. Hg Abs Dry
NOMINAL AIRLINE
INDUCTION AIR PRESSURE, in. Hg Abs Dry

FIGURE 4.5-11

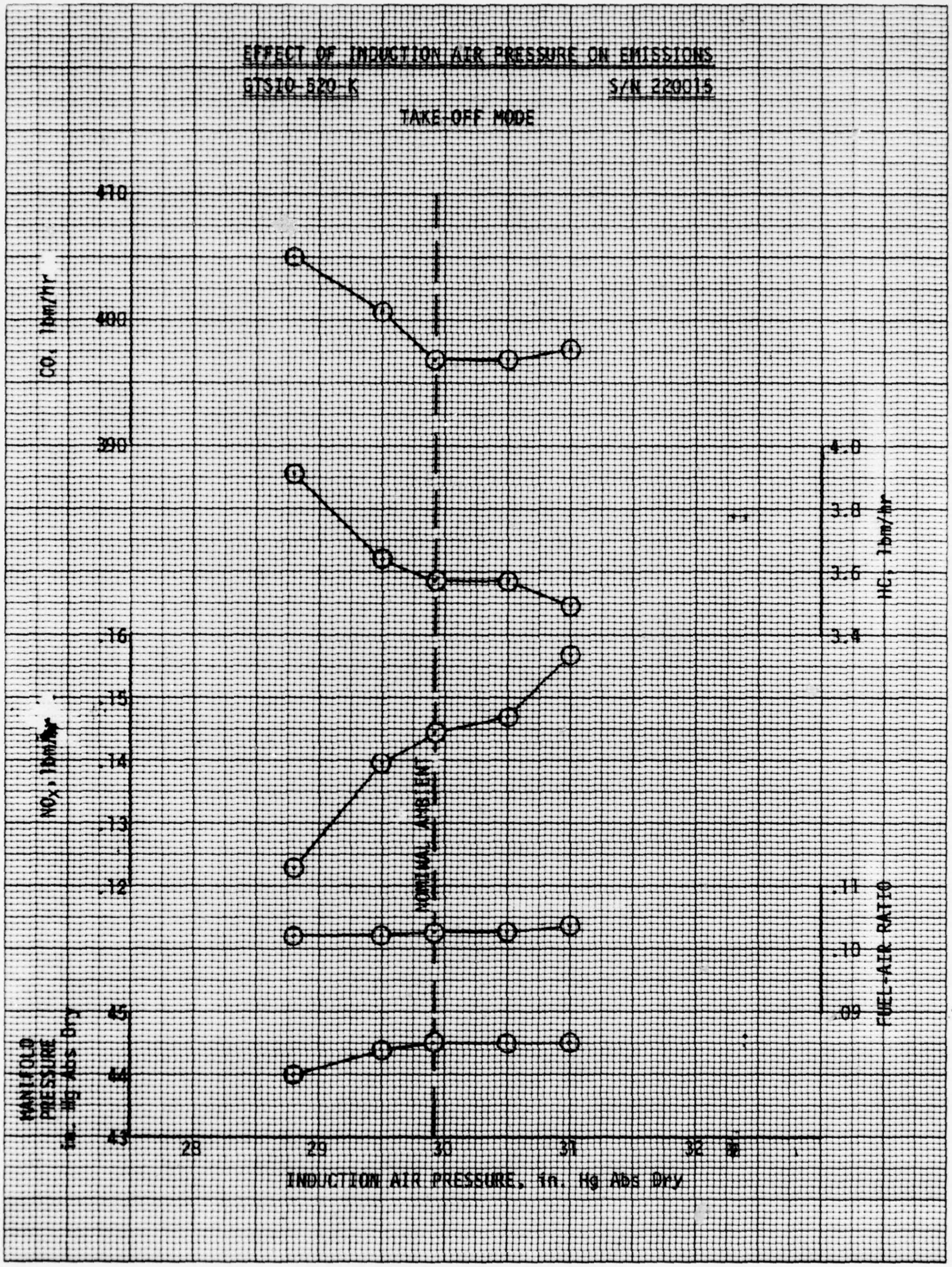
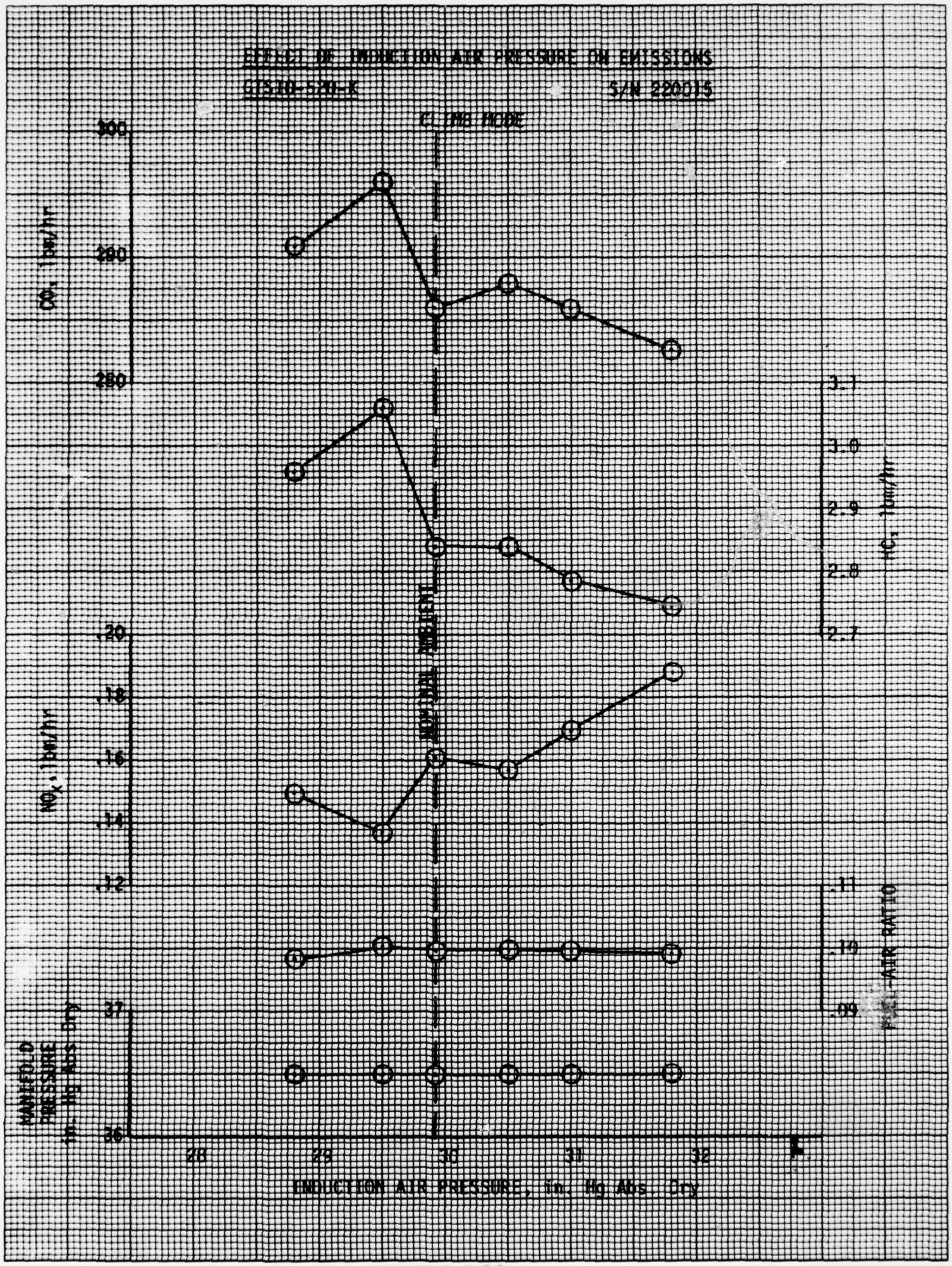
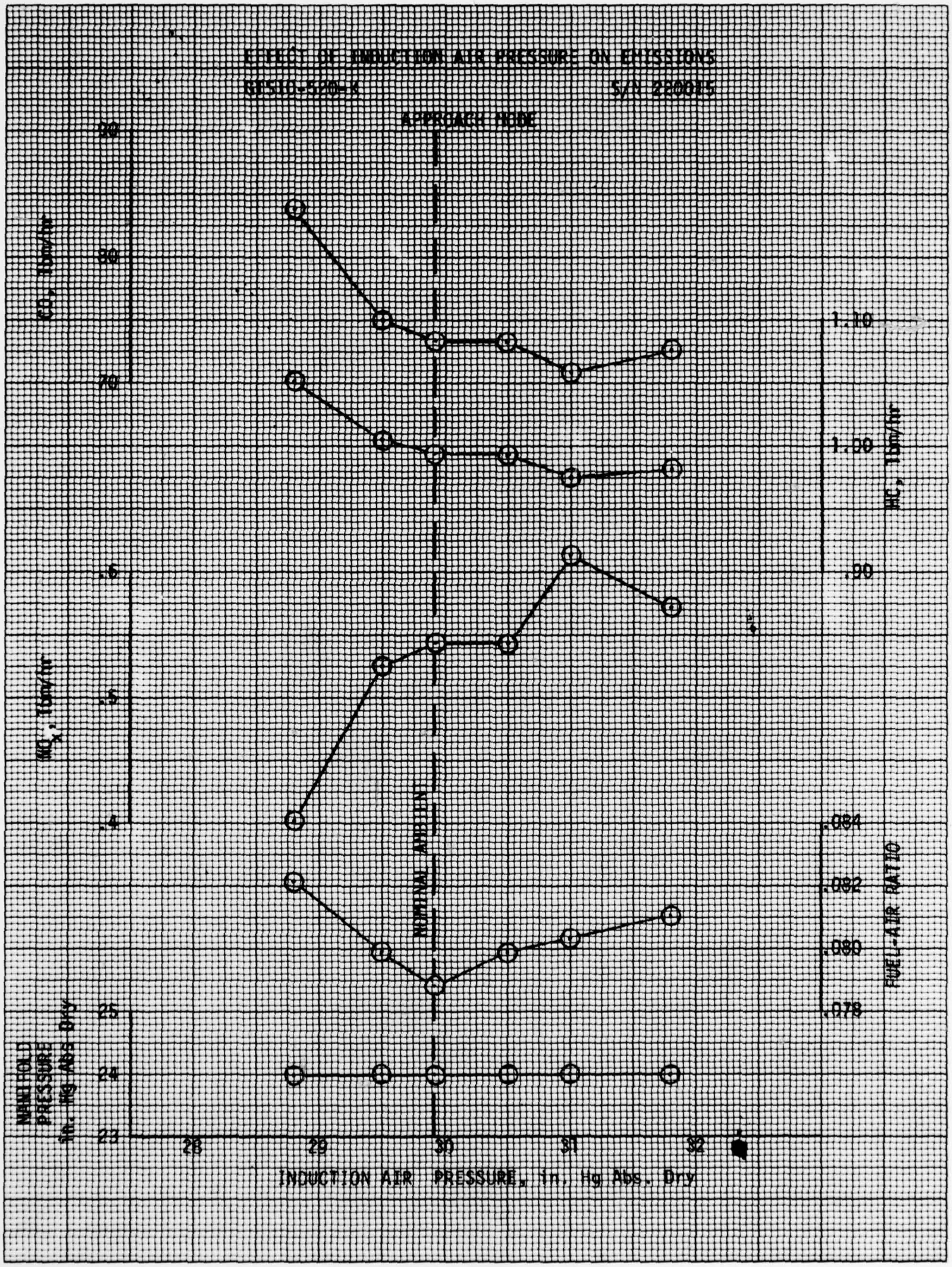

EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
GTSIO-520-K
S/N 220015
TAKE-OFF MODE
CO, lbm/hr
410
400
390
HC, lbm/hr
4.0
3.8
3.6
3.4
NO_x, lbm/hr
.16
.15
.14
.13
.12
NOMINAL AMBIENT
FUEL-AIR RATIO
.11
.10
.09
MANIFOLD PRESSURE in. Hg Abs Dry
45
44
43
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs Dry

FIGURE 4.5-12



EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
GTSIO-520-K
S/N 220015
CLIMB MODE
NOMINAL AMBIENT
CO, lbm/hr
300
290
280
HC, lbm/hr
3.1
3.0
2.9
2.8
2.7
NO_x, lbm/hr
.20
.18
.16
.14
.12
FUEL-AIR RATIO
.11
.10
.09
MANIFOLD PRESSURE in. Hg Abs Dry
37
36
28
29
30
31
32
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.5-13



EFFECT OF INDUCTION AIR PRESSURE ON EMISSIONS
GTSIO-520-K
S/N 220015
APPROACH MODE
CO, lbm/hr
NOx, lbm/hr
MANIFOLD PRESSURE in. Hg Abs Dry
HC, lbm/hr
FUEL-AIR RATIO
NOMINAL AMBIENT
INDUCTION AIR PRESSURE, in. Hg Abs. Dry

FIGURE 4.5-14

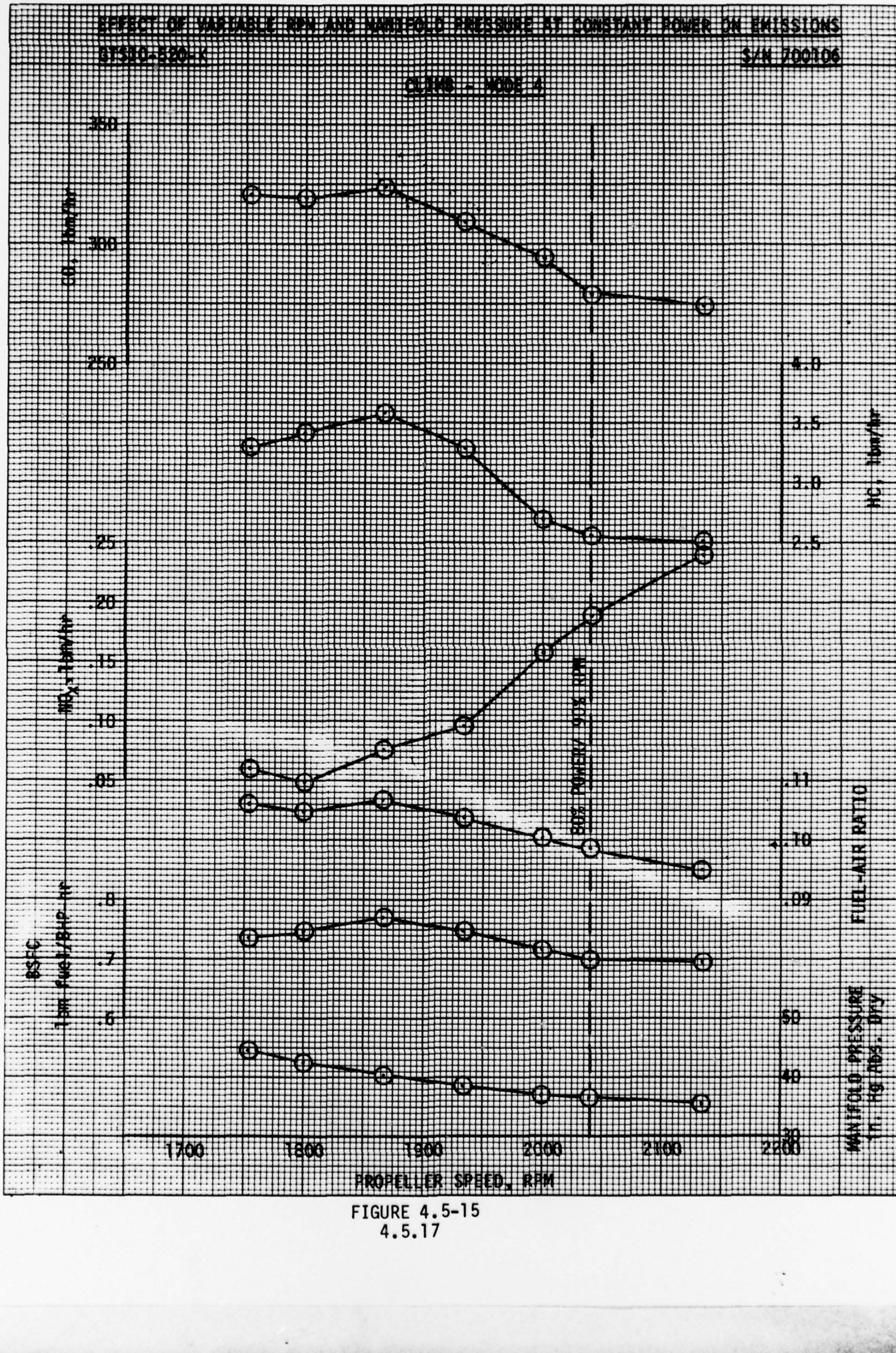

EFFECT OF VARIABLE RPM AND MANIFOLD PRESSURE AT CONSTANT POWER ON EMISSIONS
GTSIO-520-K
S/N 700106
CLIMB - MODE 4
CO, lbm/hr
350
300
250
HC, lbm/hr
4.0
3.5
3.0
2.5
NO_x, lbm/hr
.25
.20
.15
.10
.05
80% POWER/ 90% RPM
FUEL-AIR RATIO
.11
.10
.09
BSFC
lbm fuel/BHP-hr
.8
.7
.6
MANIFOLD PRESSURE
in. Hg Abs. Dry
50
40
30
1700
1800
1900
2000
2100
2200
PROPELLER SPEED, RPM

FIGURE 4.5-15

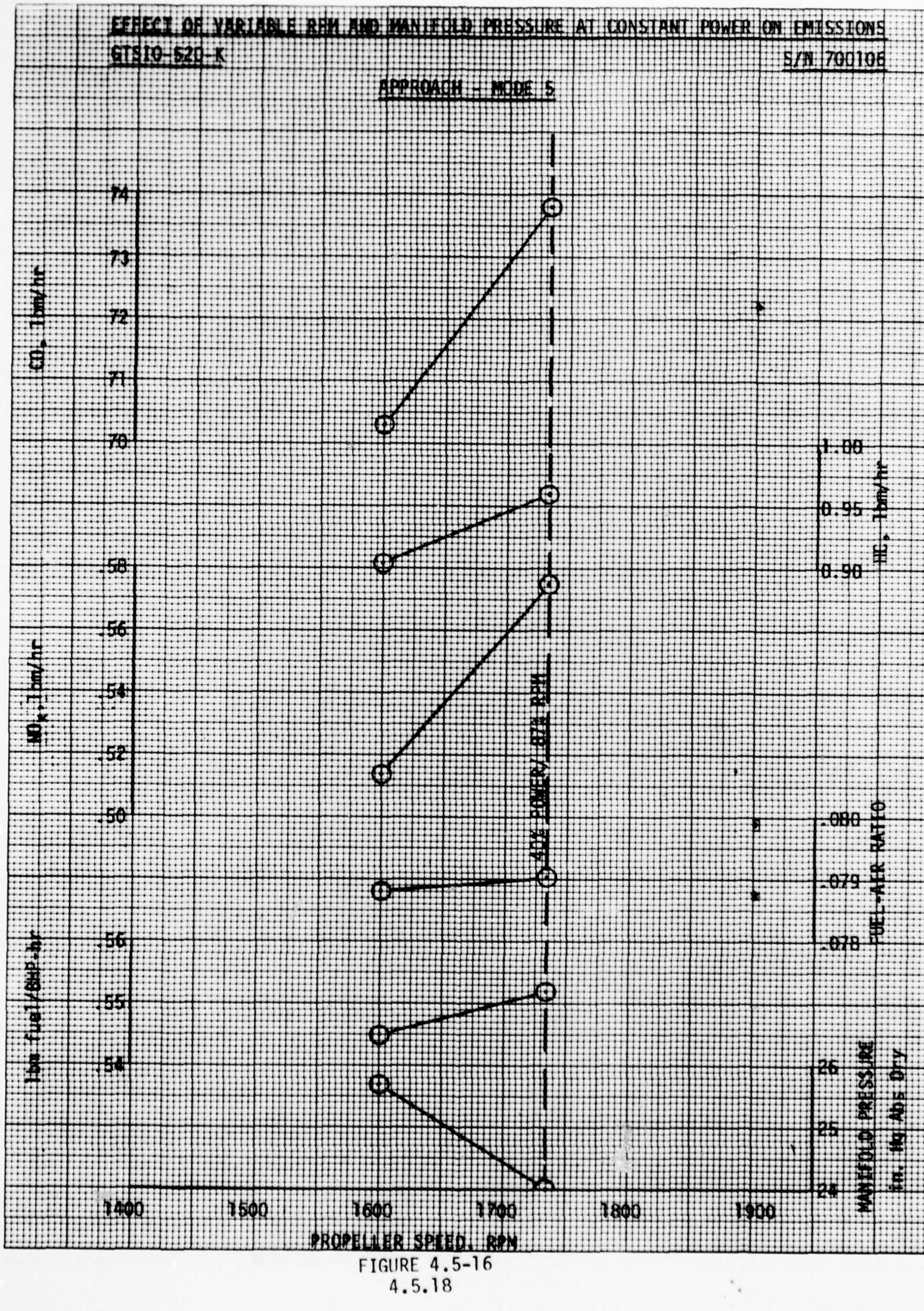

EFFECT OF VARIABLE RPM AND MANIFOLD PRESSURE AT CONSTANT POWER ON EMISSIONS
GTSIO-520-K
S/N 700106
APPROACH - MODE 5
CO, lbm/hr
NO_x, lbm/hr
lbm fuel/BHP-hr
HC, lbm/hr
FUEL-AIR RATIO
MANIFOLD PRESSURE
in. Hg Abs Dry
PROPELLER SPEED, RPM

FIGURE 4.5-16

5. IO-520 / CESSNA 210 FLIGHT TEST RESULTS

Section 4 of this report has identified the effect of modal leaning on exhaust emissions through extensive engine stand testing for five TCM engines. To determine what emission reductions are possible, it became necessary to note the difference between an uninstalled engine (test stand installation) and an installed engine (aircraft installation) operational safety limits. Since the IO-520 engine series represent a major portion of TCM engines produced the IO-520/Cessna 210 aircraft was chosen for evaluation.

The objectives of the flight tests were threefold.

1. Establish Baseline engine acceleration and cooling characteristics for the IO-520/Cessna 210 installation.

2. Determine the IO-520 engine acceleration and cooling characteristics with a fuel injection system modified for Case 2 fuel flow for ambient temperatures ranging from 0 - 100°F.

3. Identify operational and flight safety limitations associated with leaning the fuel-air mixture in an aircraft piston engine to reduce exhaust emissions.

A 1964 Cessna 210-D, S/N 210-68499, registration number N17TC (owned and operated by TCM) was selected for flight testing, requiring a conversion of the IO-520-D engine (updraft throttle body installation) to an IO-520-L (downdraft throttle body installation).

Instrumentation included engine speed (RPM), manifold pressure, fuel flow, throttle angle, cylinder head temperature (CHT), exhaust gas temperature (EGT), fuel temp, oil temp, cooling air temp in, cooling air temp out, induction air temp and ambient air temp (OAT). Engine speed, manifold pressure, fuel flow and throttle angle were recorded on an oscillograph. The remaining temperatures were recorded on a Honeywell temperature chart recorder.

Additional data logged manually consisted of cooling air ΔP, pressure altitude, indicated airspeed, cowl flap position, wing flap position, fuel pump pressure, metered fuel pressure, oil pressure, vertical speed and mixture control position. Figures 5-1 to 5-8 show location of instrumentation.

The performance testing consisted of both steady-state and transient operation. Transient response was investigated by conducting throttle bursts from idle (600 RPM) and taxi (1200 RPM) to 100% power. Transient operation and steady-state performance was evaluated for a 40% power approach and a closed throttle approach mode. Steady-state performance was evaluated for a maximum continuous power cooling climb and an 80% power cooling climb. The cooling climb was based on the requirements of Part 23 of the Federal Aviation Regulations, Section 23-1047, entitled "Cooling Test Procedures for Reciprocating Engine Powered Airplane", dated June 1974. The manual mixture control was retained in the full-rich detent for all transient and approach testing. For cooling climb testing the mixture was adjusted to maintain constant brake specific fuel consumption at 0.490. Each

series of tests was performed with the standard production fuel injection system to establish baseline cooling and engine performance characteristics of the engine/airframe system as it was originally type certificated. Also each series of tests was performed with a modified fuel metering cam and an adjustable fuel bypass system to obtain Case 2 fuel flows. The metering cam was contoured to obtain Case 2 fuel flow from taxi thru the wide open throttle (WOT) RPM range. The fuel bypass system consisted of a needle valve, housing block, tubing and fittings as required to bypass fuel around the metering cam from the pressure side of the fuel pump directly to the fuel distributing block. This system was necessary to supplement and adjust the fuel flows provided by the modified cam at idle and taxi RPM.

Overall results of the engine installed testing is summarized in Table 5-1 for cold, normal, and hot weather conditions. The test results for each mode are described in the following subsections.

- Cold Temperature Testing

  Cold weather testing (30°F) was conducted at Fargo, North Dakota and (0°F) at the Eglin Air Force Base Climatic Lab. At 30°F ambient temperatures no acceleration problems occurred for the taxi or approach modes for the Case 2 fuel system. Further testing at 0°F was therefore mandatory as colder inlet conditions would produce leaner fuel-air ratios since the present fuel injection system is not temperature compensating. Suitable environmental conditions could not be found and, as a result, TCM used the Eglin Air Force Base Climatic Hangar which has the capability of maintaining 0°F and a wind velocity simulating the approach mode. Results at 0°F for the baseline fuel schedule were acceptable, however, Case 2 acceleration from taxi and idle was impossible as the engine would not operate at those fuel flows. Acceleration from the simulated approach mode was acceptable for the Case 2 fuel system.

  As expected, no cylinder head overheating occurred during any of the cold ambient testing.

  Figure 5-9 depicts a cold weather (30°F) acceleration test for the Baseline fuel schedule. The curves represent absolute manifold pressure, engine RPM, and fuel flow as a function of time. The acceleration test was an instantaneous throttle burst from idle. Note that engine speed immediately responded from zero time, and after 3.4 seconds had elapsed the engine had attained full speed and fuel flow. Figure 5-10 illustrates a cold weather (30°F) throttle burst from idle for the Case 2 fuel schedule. As in the preceeding example manifold pressure peaked in less than a second, however, engine speed and fuel flow began to rise, but then decreased. The engine would continue to run at this low speed until the throttle was brought back to idle and then slowly moved to the full throttle position.

- Standard Temperature Testing

  Testing at standard ambient conditions (50° - 70°F) was conducted at the TCM facility in Mobile, Alabama. No acceleration problems occurred for Baseline fuel schedules at idle, taxi or approach. However, for Case 2 fuel schedules, hesitation and excessive engine roughness was noted at idle and taxi speeds. The approach mode acceleration was acceptable. Cylinder head overheating did not occur in the takeoff or climb modes at Baseline or Case 2 fuel schedules.

TABLE 5-1

IO-520/Cessna 210 Case 2 Fuel Flow (Aircraft Installed Results)

(Reference 21: TCM Flight Test Report)

IO-520/Cessna 210	Case 2 Mixture Schedule Uninstalled Safety Hazard	Case 2 Mixture Schedule Installed Safety Results		
Temperature Range	64 - 88°F	0°F and 30°F Testing	50 - 70°F Testing	90 - 100°F Testing
Idle	Acceleration Limit	Engine would not accelerate at 30°F Engine would not operate at 0°F	Engine rough, poor acceleration	Acceptable
Taxi	Acceleration Limit	Engine would not operate at 0°F	Engine rough, Acceptable acceleration	Acceptable
Takeoff	Cylinder Head Limit (CHT - 460°F)	Cylinder head temperature within limits (CHT - 358°F)	Acceptable (CHT - 403°F)	Acceptable (CHT - 408°F)
Climb	Cylinder Head Limit (CHT - 460°F)	Cylinder head temperature within limits (CHT - 381°F)	Acceptable (CHT - 399°F)	Acceptable (CHT - 399°F)
40% Approach	Acceleration Limit	Simulated approach at 0°F was acceptable	Acceptable	Acceptable
Closed Throttle Approach	Acceleration Limit	Simulated approach at 0°F was acceptable	Acceptable	Acceptable

• Hot Temperature Testing

Hot weather testing was conducted near Del Rio and Laredo, Texas, to provide the required 90° - 100°F ambient temperature. With the less dense induction air (richer mixture) no acceleration problems occurred for Baseline or Case 2 fuel schedules.

Figure 5-11 depicts the Case 2 fuel schedule results for the cooling climb tests at both cold and hot day conditions. The maximum and minimum cylinder head temperatures, as well as the outside air temperatures are plotted as a function of pressure altitude. A maximum cylinder head temperature of 395°F occurred during the hot day testing, well within the Model Specification limit. The Case 2 fuel schedule at takeoff and climb were therefore acceptable.

Table 5-2 compares the flight test minimum installed fuel flows to the minimum uninstalled test stand (Case 2) fuel flows.

TABLE 5-2

IO-520 INSTALLED & UNINSTALLED MINIMUM FUEL FLOWS

Mode Number	Mode Name	Manifold Pressure	RPM	Cessna 210 Minimum Installed Fuel Flow	Uninstalled Test Stand Case 2 Fuel Flow
1	Idle	-	600	8.0	6.0
2	Taxi	-	1200	13.5	12.6
3	T/O	W.O.T.	2850	140.0	143.0
4	Climb	27.7	2565	107.0	107.0
5	Appr.	18.0	2480	60.0	60.0

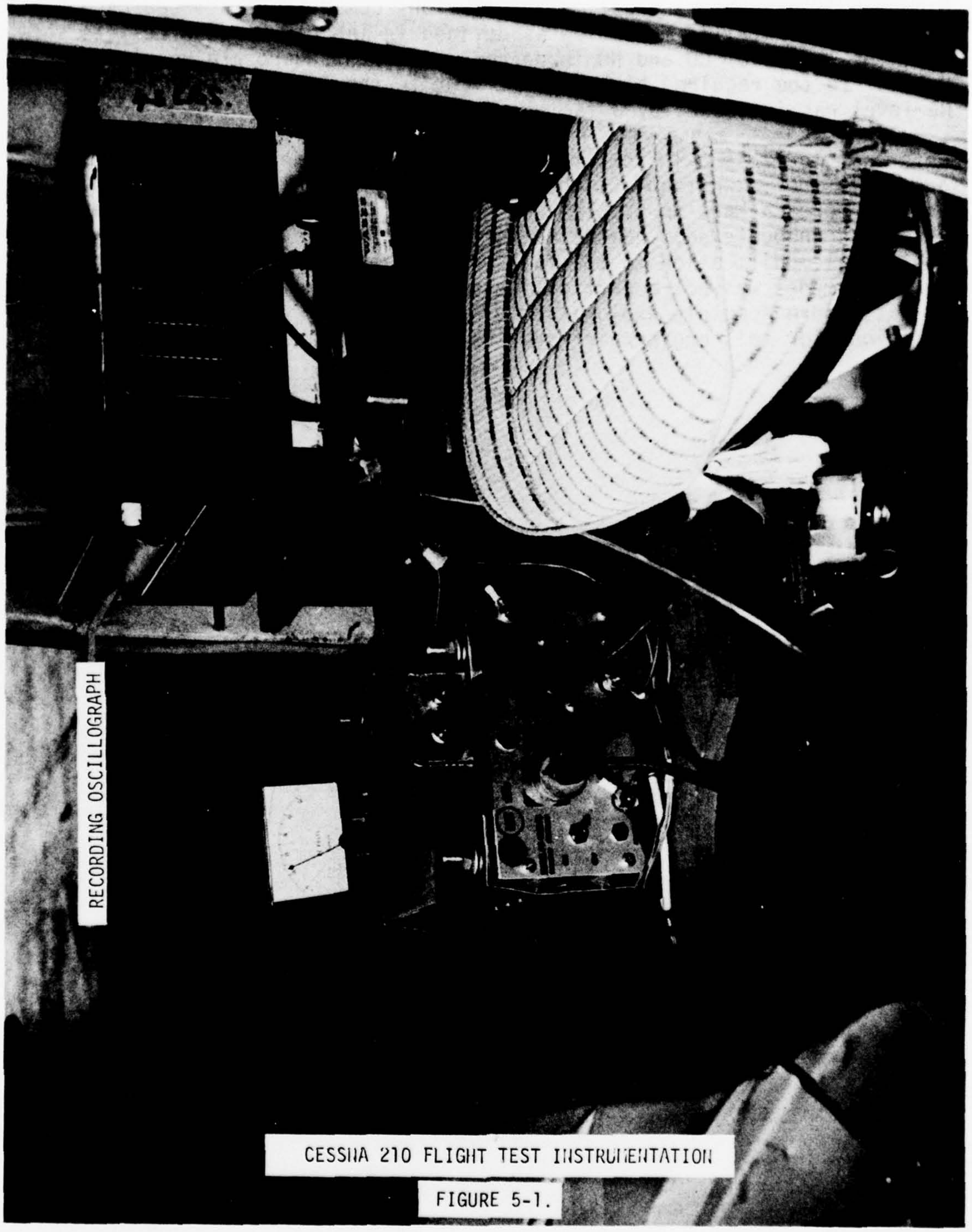
Differences in the Idle-Taxi fuel flows may be explained by considering the present fuel injection system design. Rich mixtures are required at the low power idle-taxi regime to provide adequate fuel distribution to all cylinders and to insure adequate engine transient response (acceleration). Since the present fuel system is not temperature compensating, the fuel flow required for the idle-taxi modes is dependent on the fuel-air ratio required for cold day operation. As the induction air temperature increases, the resultant fuel air ratio enrichens.

The Case 2 fuel-air ratios defined in Figures 4.2-2 and 4.2-3 for the idle-taxi modes are considered the actual installed fuel-air limits, however, since the present fuel system does not control fuel-air ratio this mixture strength cannot be maintained for all operating conditions.

Differences in the Takeoff fuel flows may be explained by realizing that during an actual takeoff maneuver the engine power decreases with altitude (for a naturally aspirated engine) and therefore the test stand (Case 2) minimum fuel flow is conservative since it was determined at maximum power conditions. Also cooling air temperatures decrease with altitude, providing a better heat transfer sink.

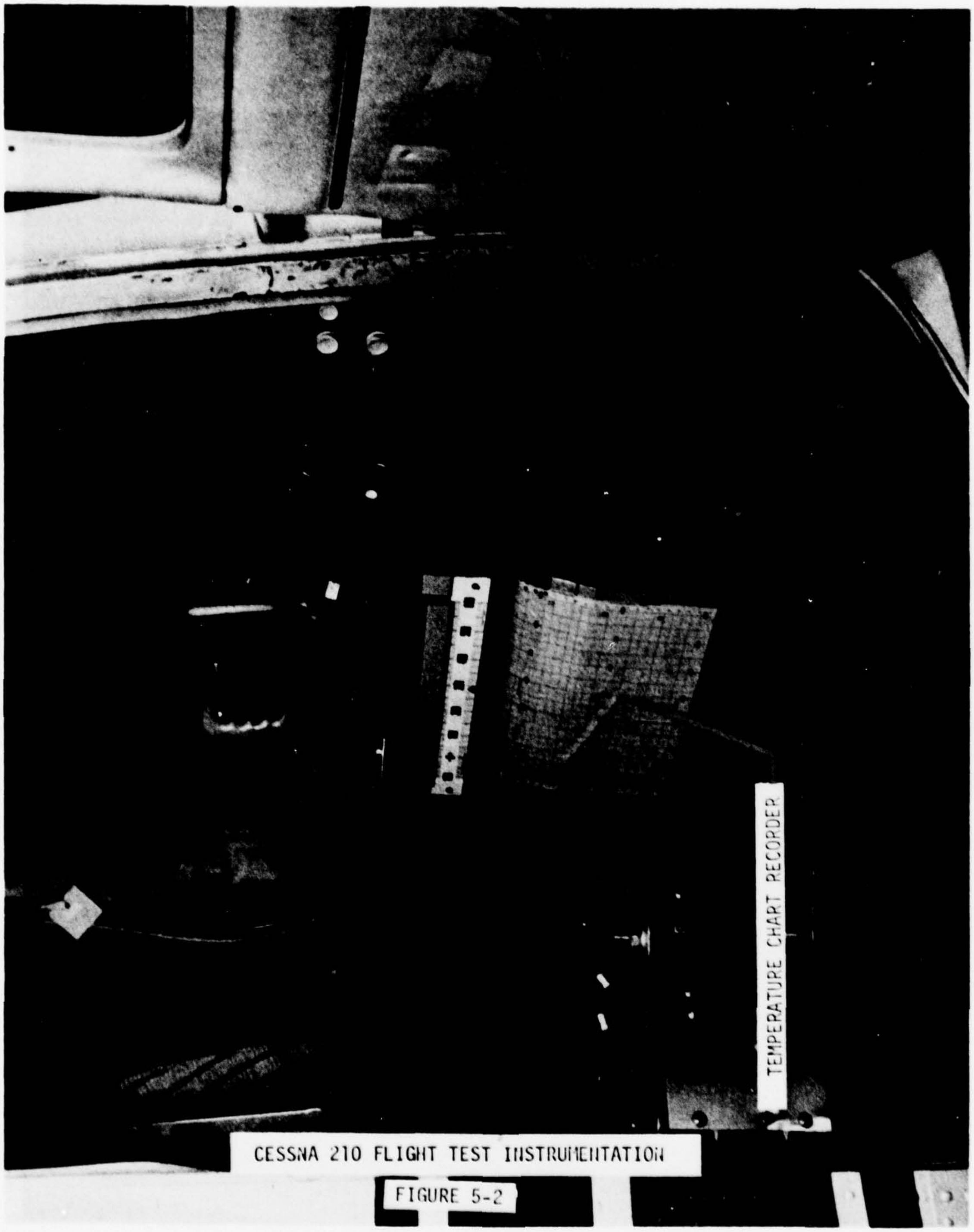
Figure 5-12 presents the estimated emissions comparisons between Case 2 ahd the minimum installed fuel flow as defined in Table 5-2. The results show that the levels of CO and NO in percent of EPA Standard are nearly the same, but due to the required higher fuel flows in the Idle and Taxi modes, the HC level has increased by a factor of 50 percent.

Reference to Table 5-1 shows that a margin in cylinder head temperatures exists in the Takeoff and Climb Modes where further leaning may be allowed. In the Approach Mode no problem with cylinder head temperatures or acceleration was encountered, indicating further leaning is also possible. Additional modification to the fuel metering cam to allow leaner operation in these modes was not a part of the present Contract work, but would permit a more complete exploration of the potential reduction of exhaust emissions for this engine/airframe installation.



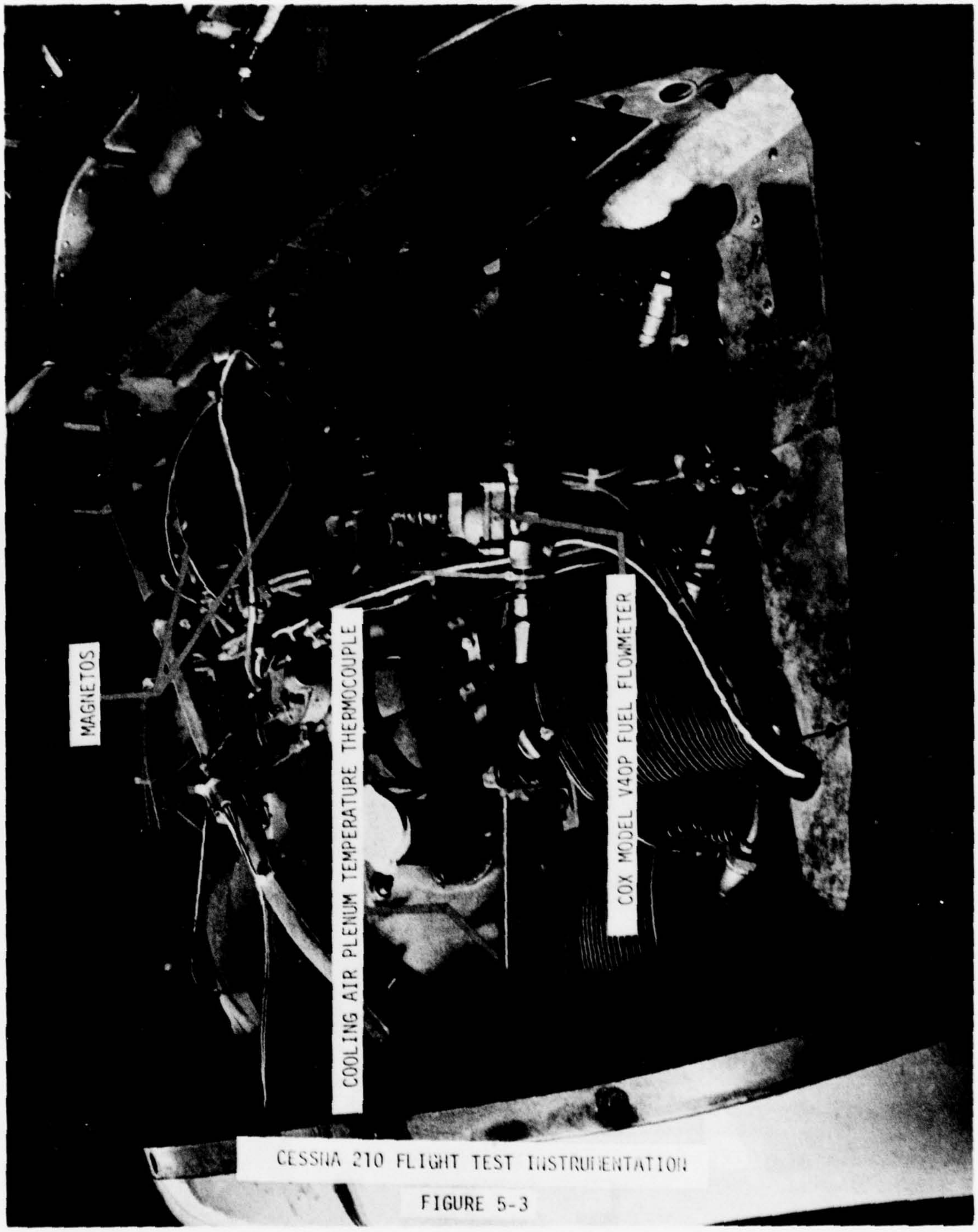
CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-1.



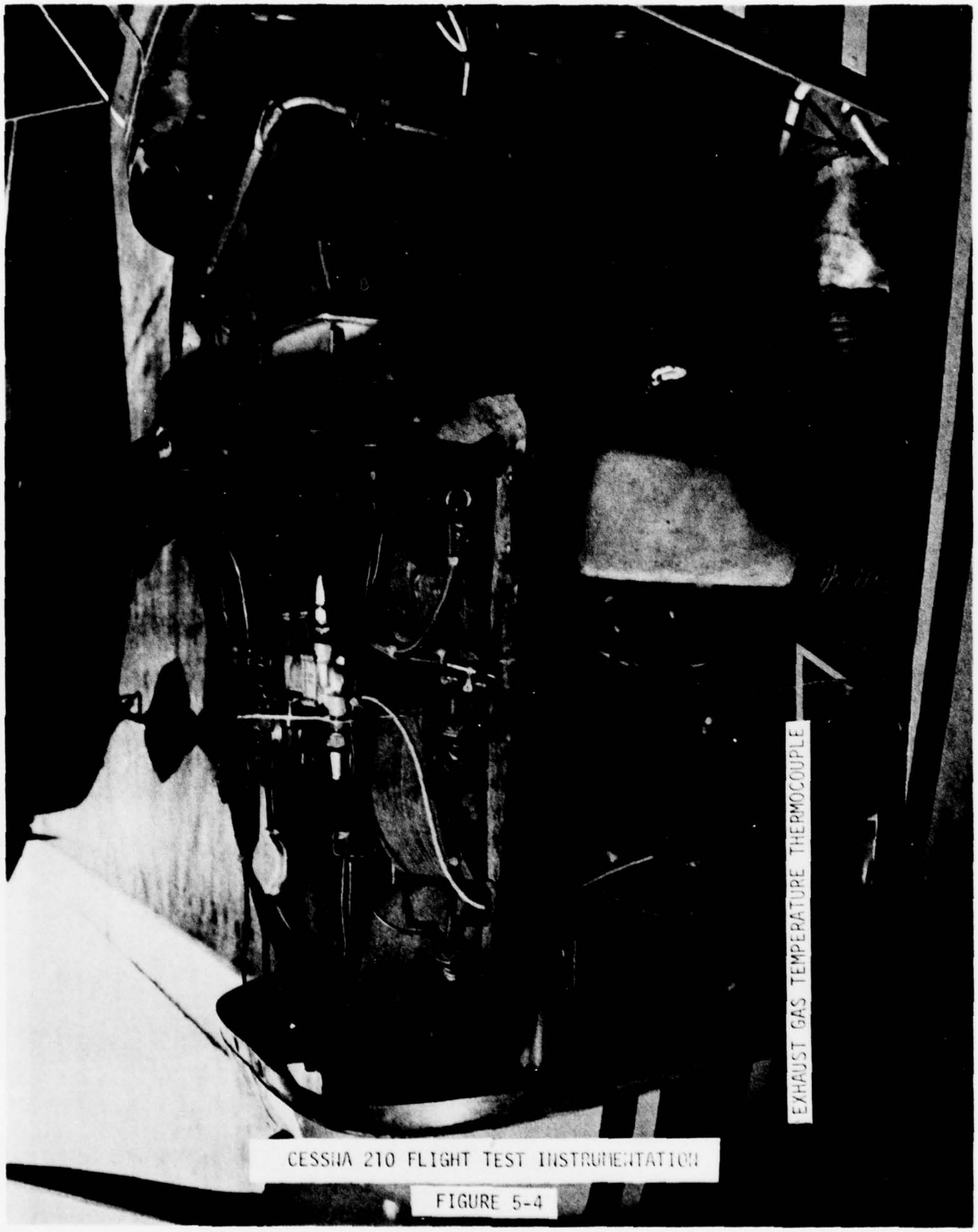
CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-2



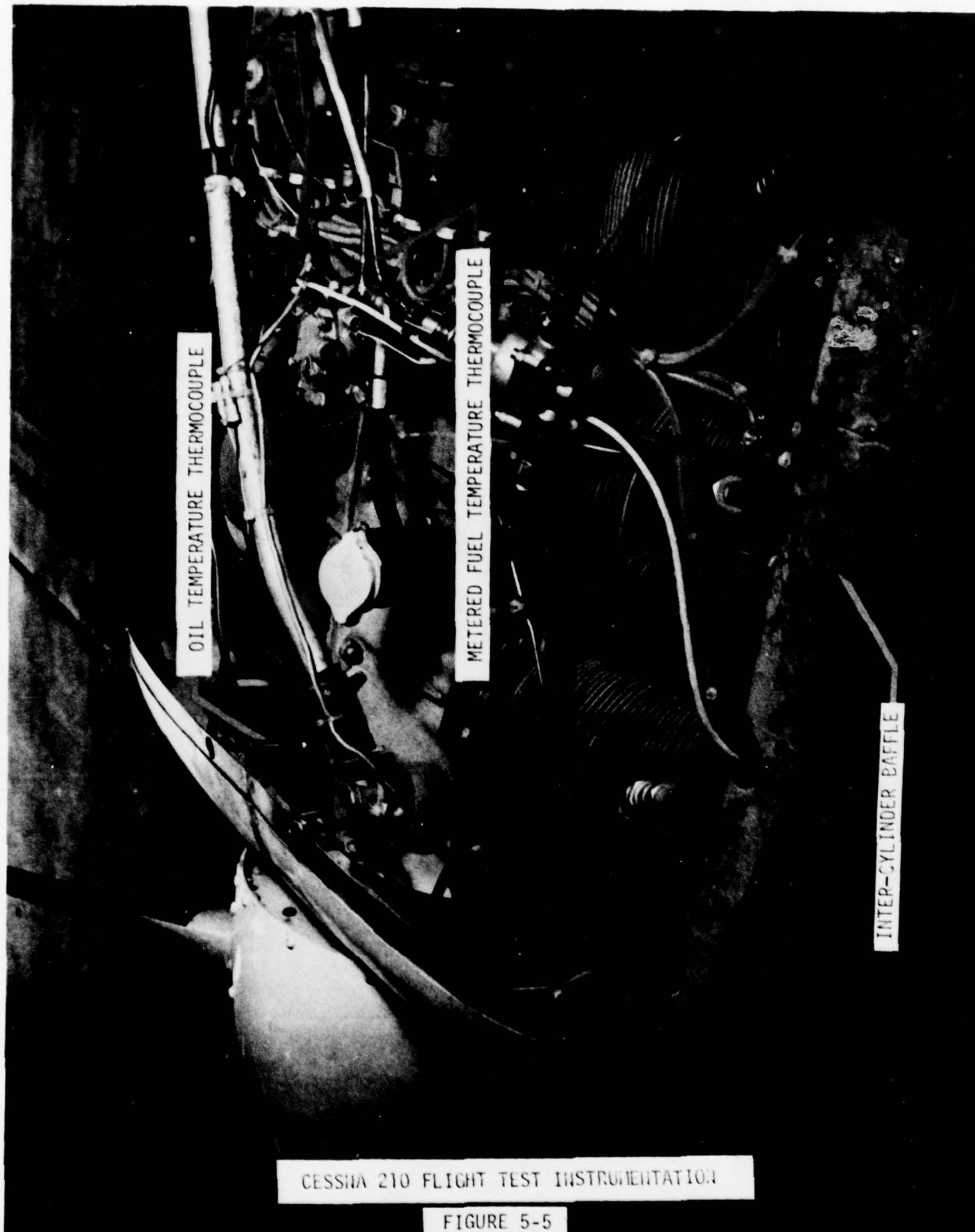
CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-3



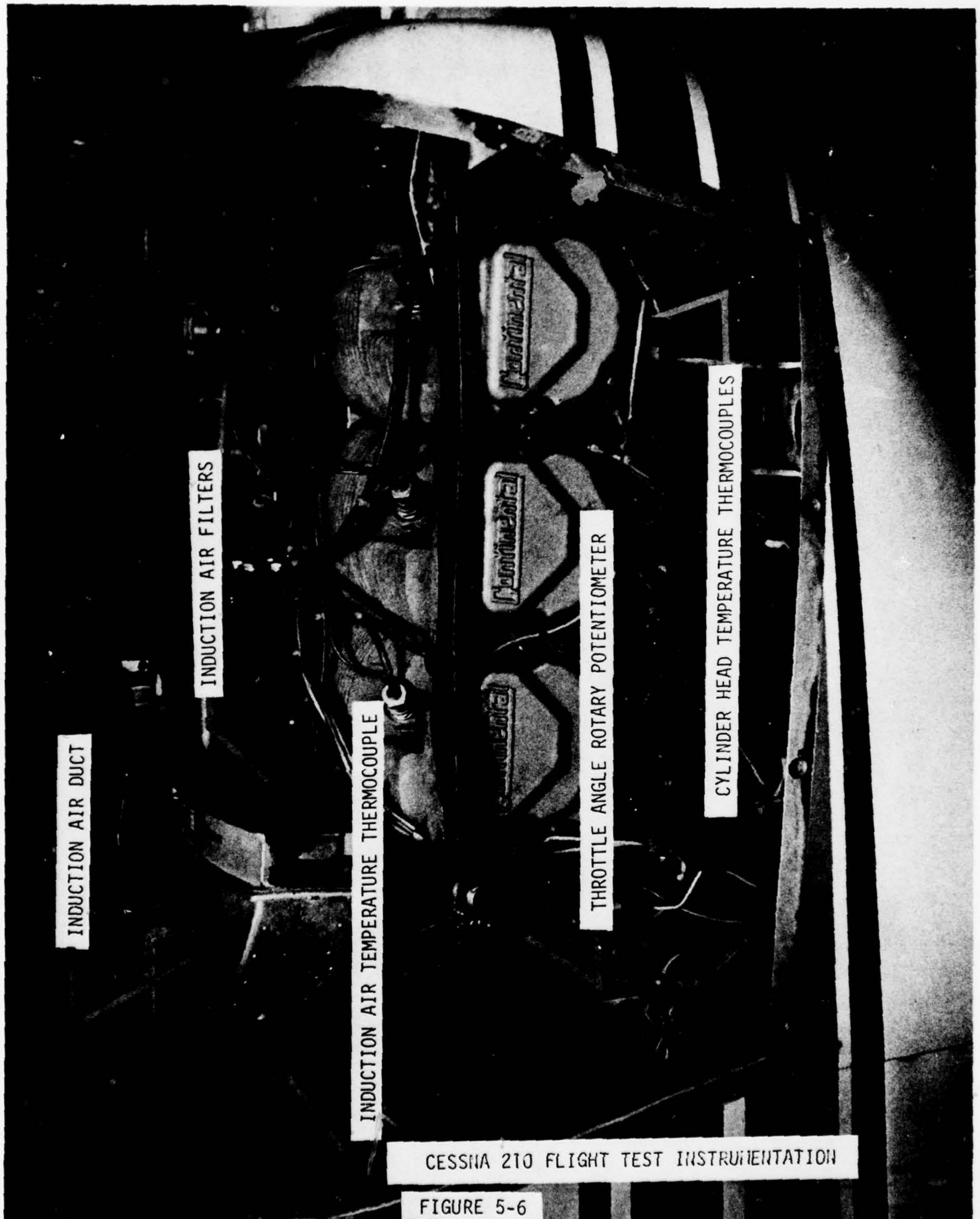
CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-4



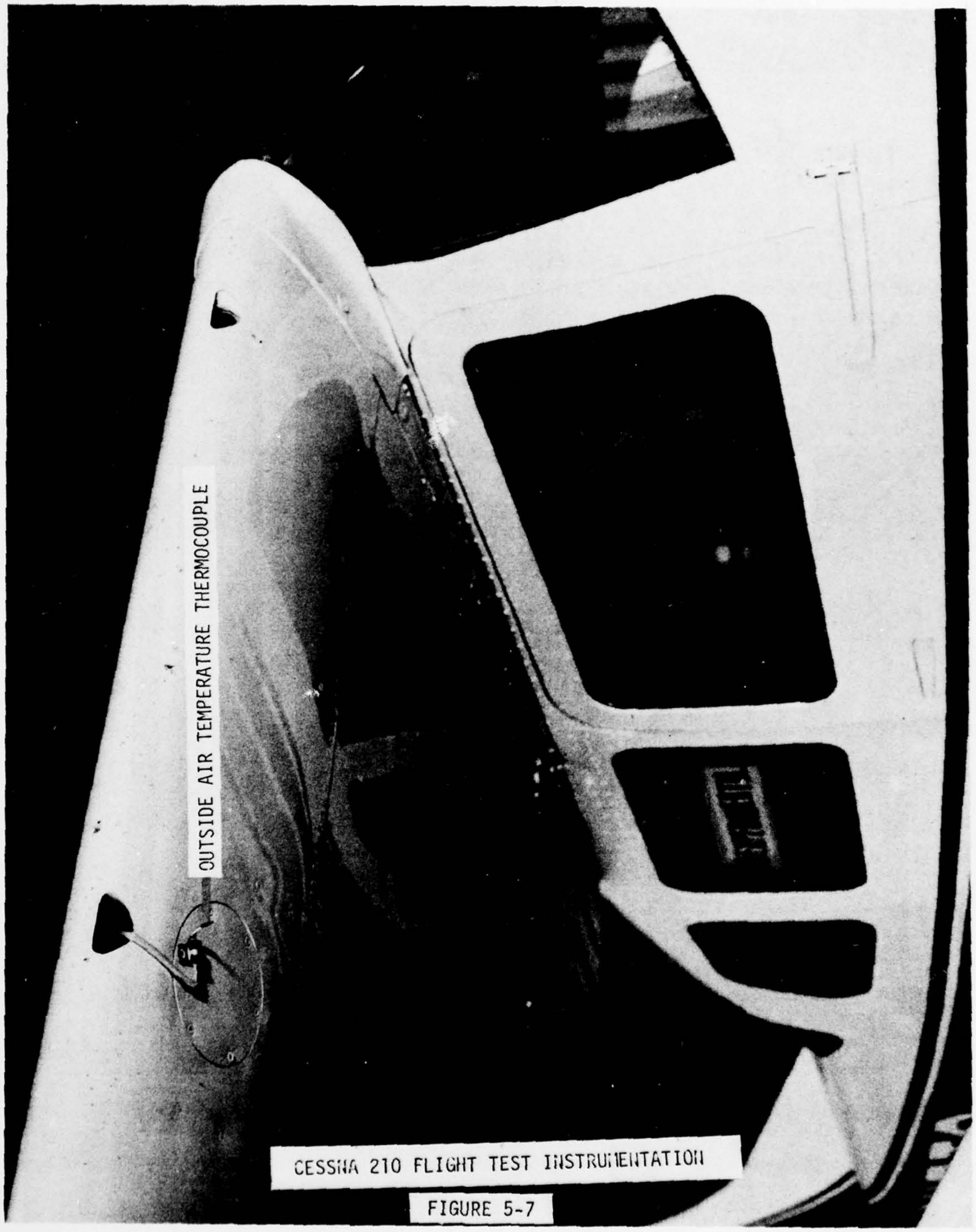
CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-5



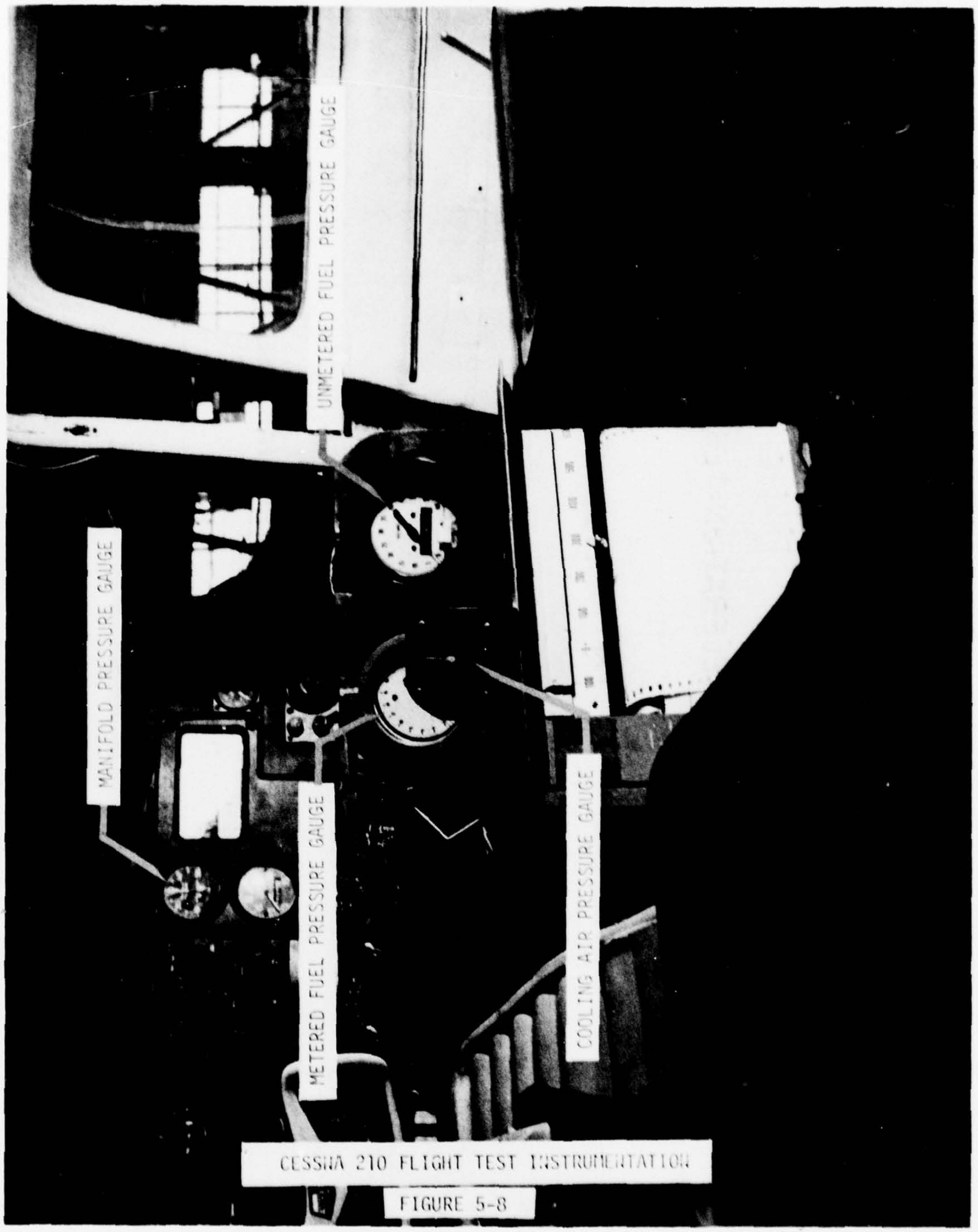
CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-6



CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-7



CESSNA 210 FLIGHT TEST INSTRUMENTATION

FIGURE 5-8

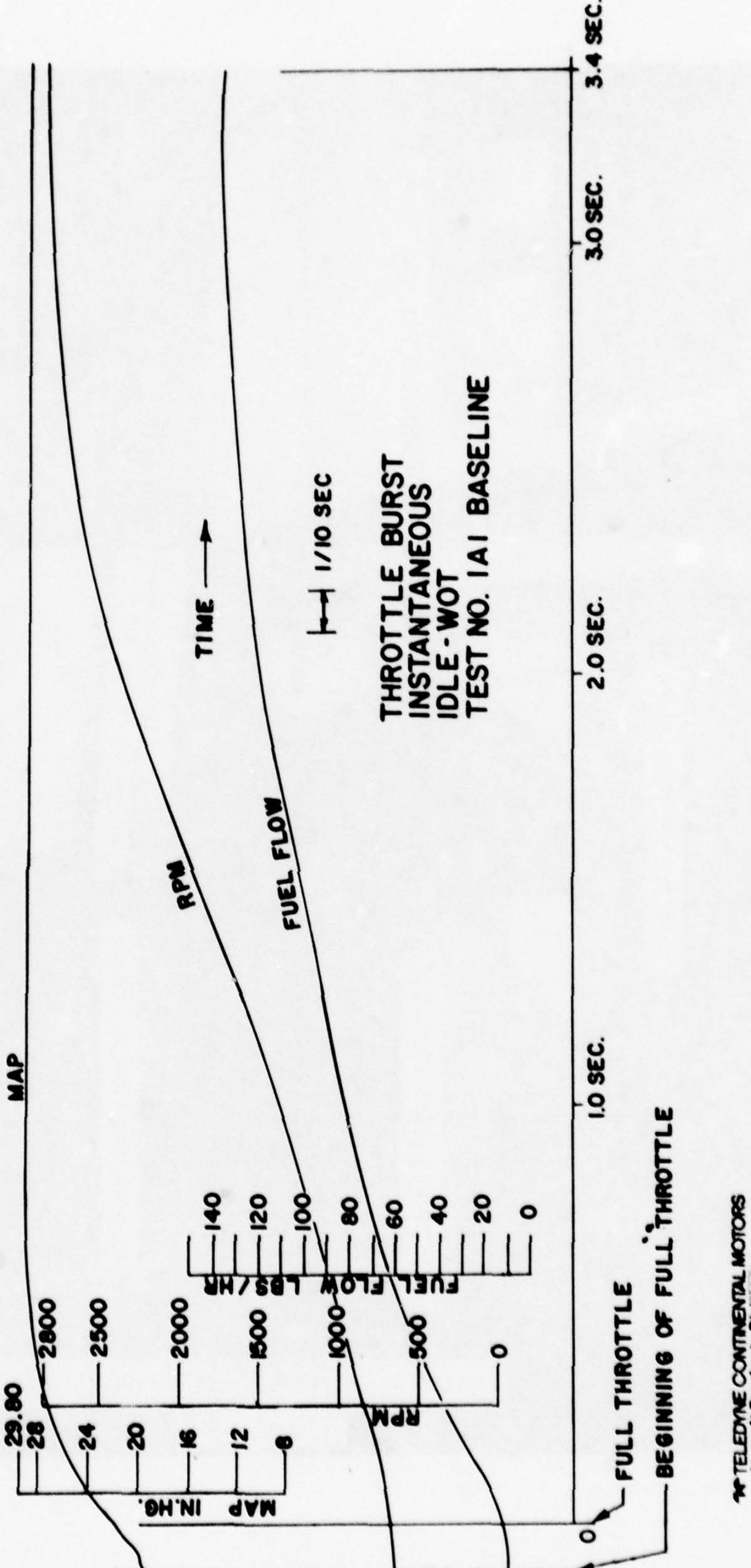


FIGURE 5-9 COLD WEATHER (30°F) ACCELERATION FROM IDLE FOR IO-520 ENGINE ON BASELINE FUEL SCHEDULE

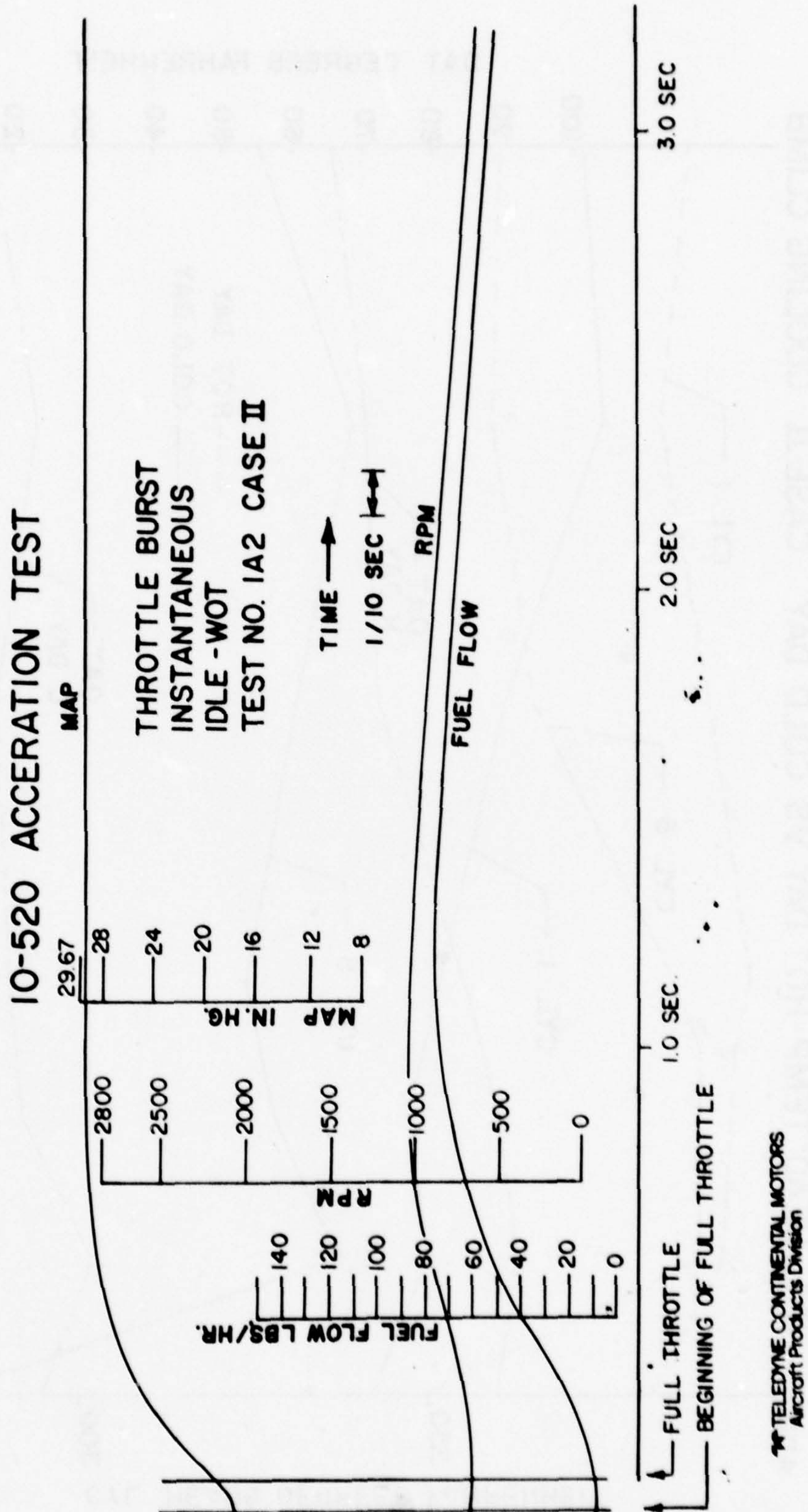


FIGURE 5-10 COLD WEATHER (30°F) ACCELERATION FROM IDLE FOR IO-520 ENGINE ON CASE 2 FUEL SCHEDULE

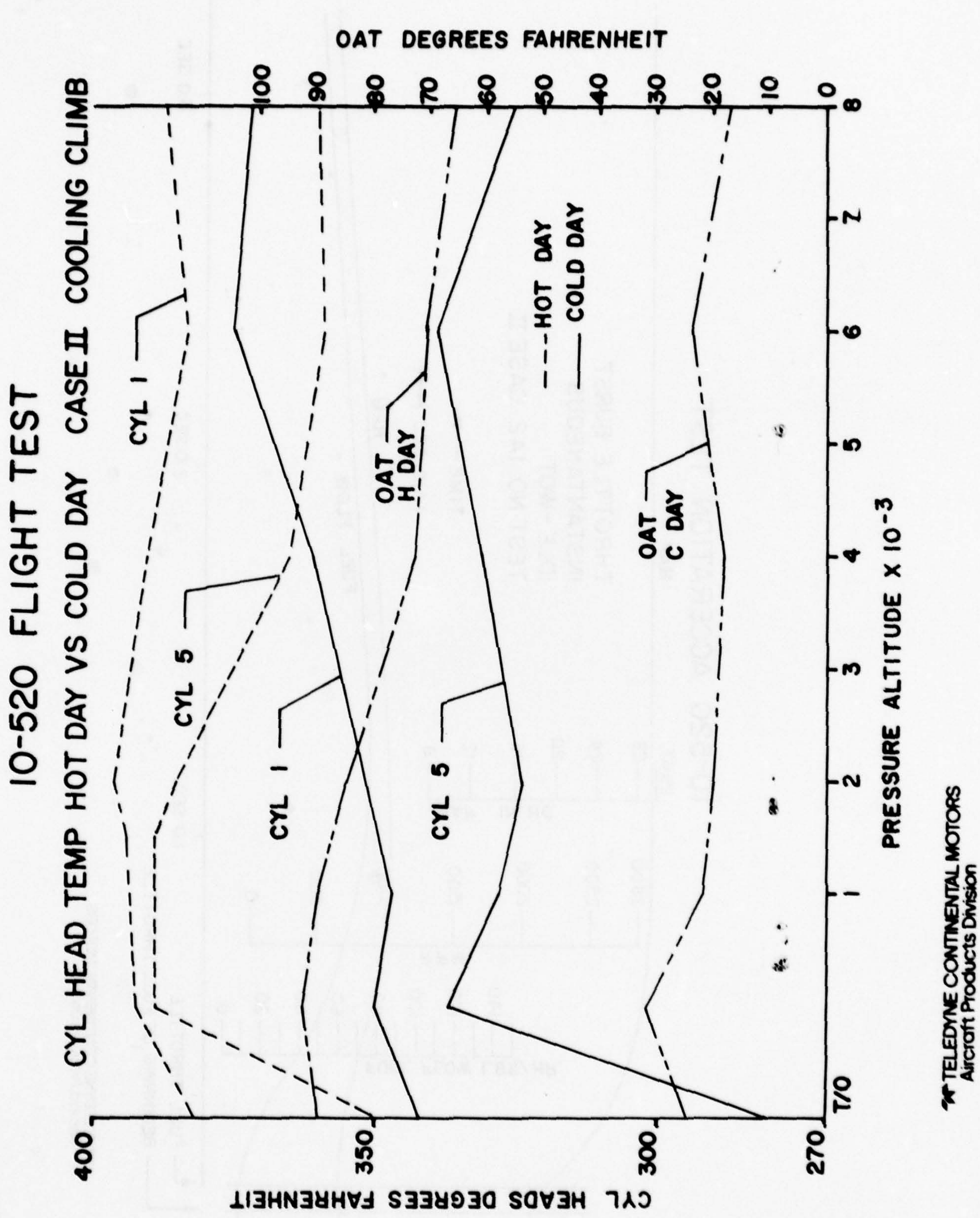

IO-520 FLIGHT TEST
CYL HEAD TEMP HOT DAY VS COLD DAY CASE II COOLING CLIMB
OAT DEGREES FAHRENHEIT
100
90
80
70
60
50
40
30
20
10
0
CYL HEADS DEGREES FAHRENHEIT
400
350
300
270
T/O
1
2
3
4
5
6
7
8
PRESSURE ALTITUDE X 10^{-3}
CYL 1
CYL 5
CYL 1
CYL 5
OAT H DAY
OAT C DAY
HOT DAY
COLD DAY
TELEDYNE CONTINENTAL MOTORS
Aircraft Products Division

FIGURE 5-11

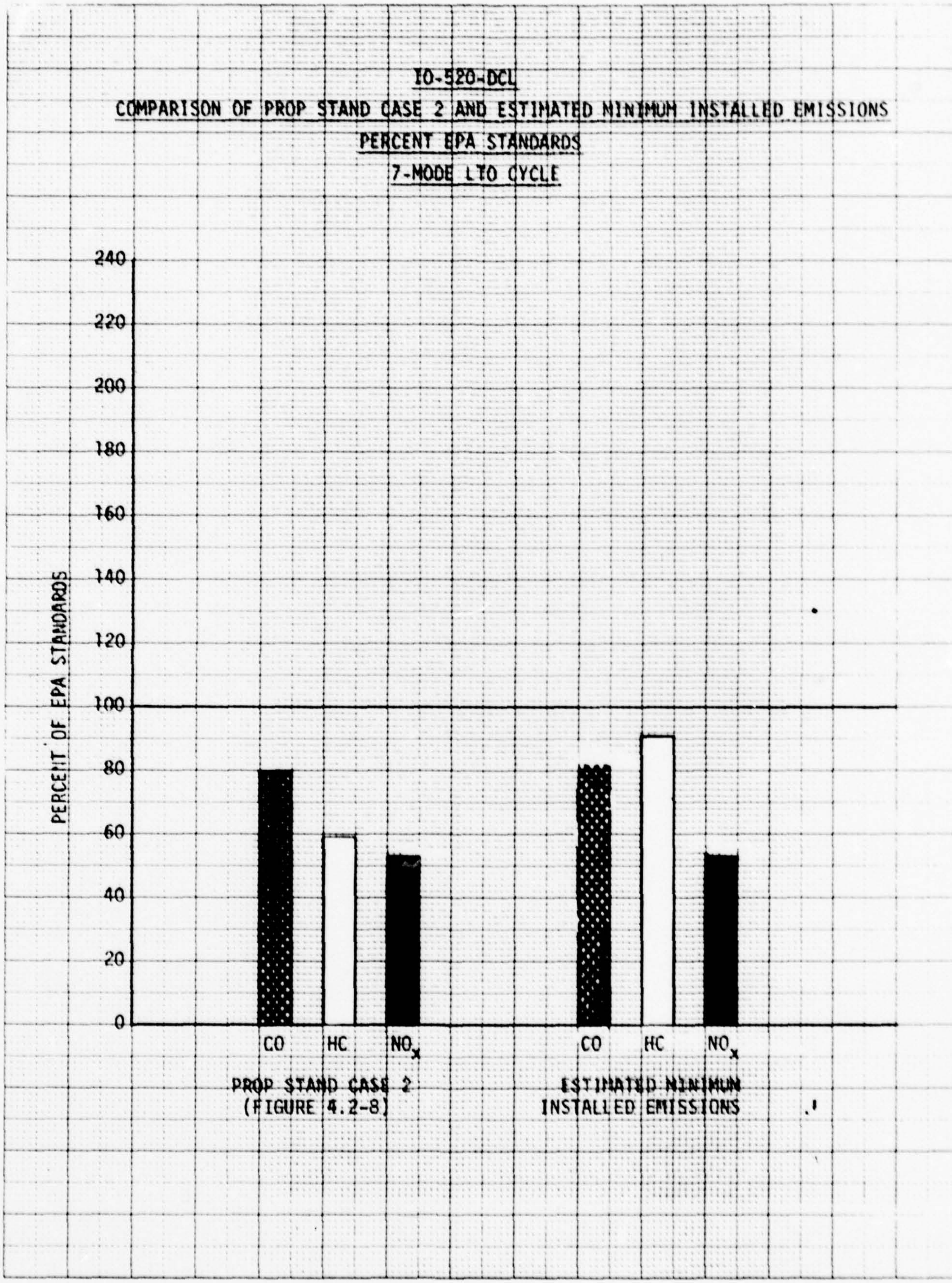

IO-520-DCL
COMPARISON OF PROP STAND CASE 2 AND ESTIMATED MINIMUM INSTALLED EMISSIONS
PERCENT EPA STANDARDS
7-MODE LTO CYCLE
PERCENT OF EPA STANDARDS
240
220
200
180
160
140
120
100
80
60
40
20
0
CO
HC
NO_x
CO
HC
NO_x
PROP STAND CASE 2
(FIGURE 4.2-8)
ESTIMATED MINIMUM
INSTALLED EMISSIONS

FIGURE 5-12

6. GENERAL EMISSIONS TRENDS

The five engines tested under the NAFEC contract are a representative cross-section of the TCM aircraft piston engine product line. They presumably would also represent the widest variation of emissions characteristics, giving a reliable data base from which to estimate the level of effort and required technology to meet the EPA standards.

The BASELINE, CASE 1 and CASE 2 emissions levels for the five engines are compiled in Figures 6-1, 6-2 and 6-3. Figure 6-1 shows the levels of carbon monoxide as a percent of EPA standards for the five engines. The engines are ranked from left to right in order of decreasing CO at BASELINE for easy comparison. The O-200-A has the highest BASELINE levels and the Tiara 6-285-B, the lowest.

Similar data is presented for HC in Figure 6-2, where the engines are presented in order to decreasing HC at BASELINE. The highest BASELINE emitter of HC is the TSIO-360-C and the lowest, the GTSIO-520-K. It is interesting to note that these two turbocharged engines fall at the two extreme HC levels. The Tiara 6-285-B and the GTSIO-520-K produce the lowest values of HC which may be contributed to by the excellent fuel-air mixture distribution to each cylinder on these engines. The air intake manifolds for both of these engines are of the "spider" type design which provides uniform air distribution to each cylinder. The IO-520-D has a runner-type intake manifold with a balance tube connecting each leg and the TSIO-360-C has a plain runner without a balance tube.

Figure 6-3 shows the results for NO, again in order of decreasing NO emissions at BASELINE.

While it is difficult to predict very precisely the expected emissions levels of an engine with respect to the EPA standards, some generalizations can be made to estimate trends. Hydrocarbon emissions are a strong function of physical engine design as well as fuel-air ratio. As was shown in the IO-520-D testing, engine operating history and age can be a strong factor in hydrocarbon production rate. Attempts have been made to predict HC levels in advance of actual engine testing with little success.

The mechanism of nitric oxide formation is very complex but tends generally to be inversely related to hydrocarbon content of the exhaust. Regardless of the reason for the increase in HC level, the NO responds inversely by decreasing. An example of this is shown in Figure 4.2-4 and 4.2-5 where original and retest IO-520-D emissions are presented for the Takeoff and Climb Modes. The increased HC levels due to increased oil consumption are accompanied by reduced NO levels. A more detailed explanation of this phenomenon may be found in Reference 20.

The fundamental problem in meeting the EPA Standards is in the reduction of carbon monoxide, however. For all of the engines except the TSIO-360-C, when the CO levels could be reduced below the limit, the HC levels were well below the Standard. Since CO is a product of the incomplete combustion of fuel, its presence is dictated by the combustion of fuel-air mixtures rich of stoichiometric. Quantifying the CO emissions levels for an engine is relatively easy, as its rate of production is principally a function of fuel-air ratio and brake mean effective pressure for a given power.

The data from all five engines was used to produce the curves shown in Figure 6-4. Regardless of the engine, the data plotted fairly consistently on this curve. Brake specific CO is shown to be a function of brake mean effective pressure and fuel-air ratio. The fuel-air ratios presented on the curve were those calculated from exhaust gas products.

Using Figure 6-4, it is possible to predict very accurately the CO emissions of an engine based on its expected operating mode power, speed and fuel-air ratio.

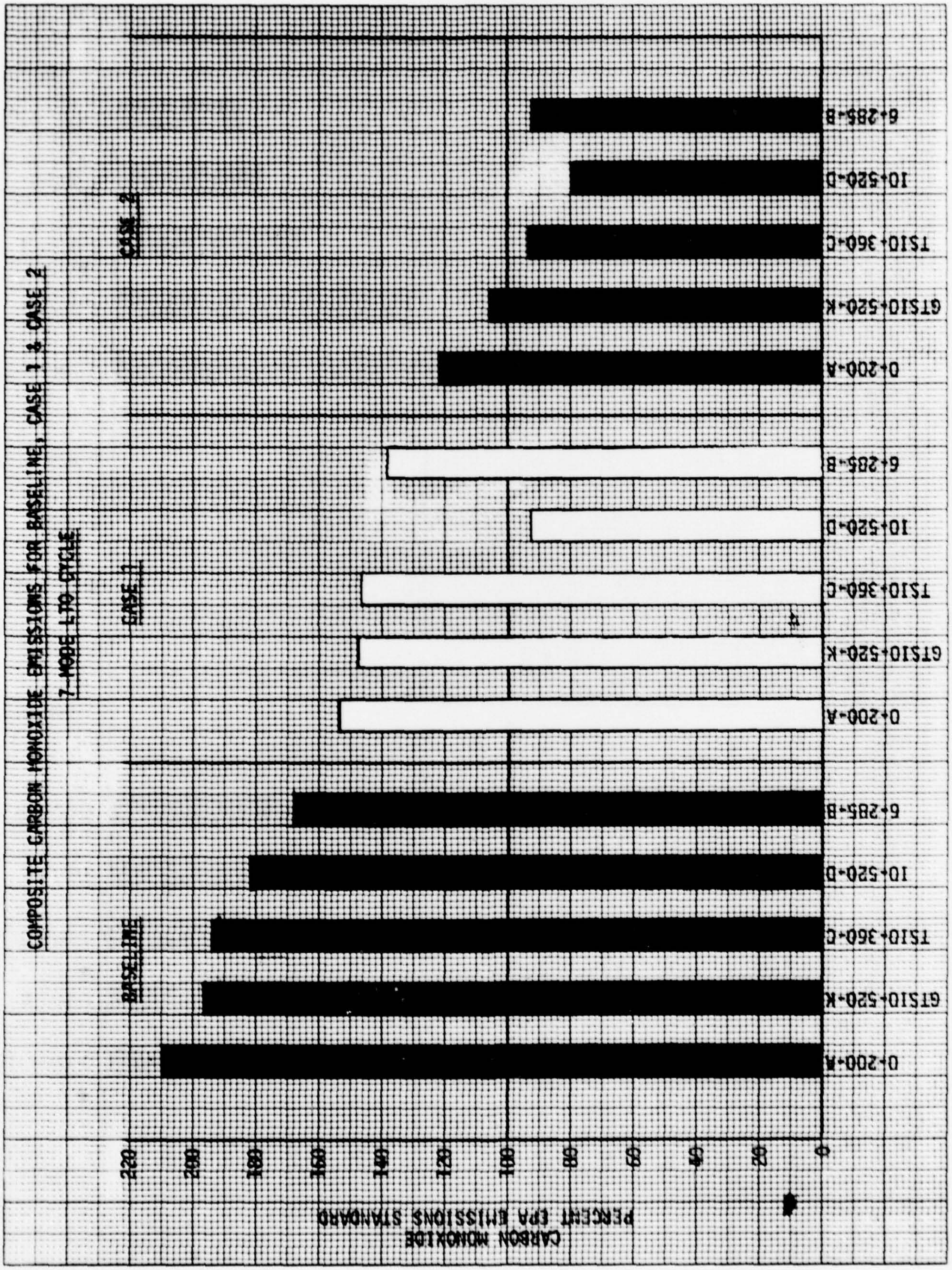

COMPOSITE CARBON MONOXIDE EMISSIONS FOR BASELINE, CASE 1 & CASE 2
7-MODE LTO CYCLE
BASELINE
CASE 1
CASE 2
CARBON MONOXIDE
PERCENT EPA EMISSIONS STANDARD
0
20
40
60
80
100
120
140
160
180
200
220
O-200-A
GTSIO-520-K
TSIO-360-C
IO-520-D
6-285-B
O-200-A
GTSIO-520-K
TSIO-360-C
IO-520-D
6-285-B
O-200-A
GTSIO-520-K
TSIO-360-C
IO-520-D
6-285-B

FIGURE 6-1

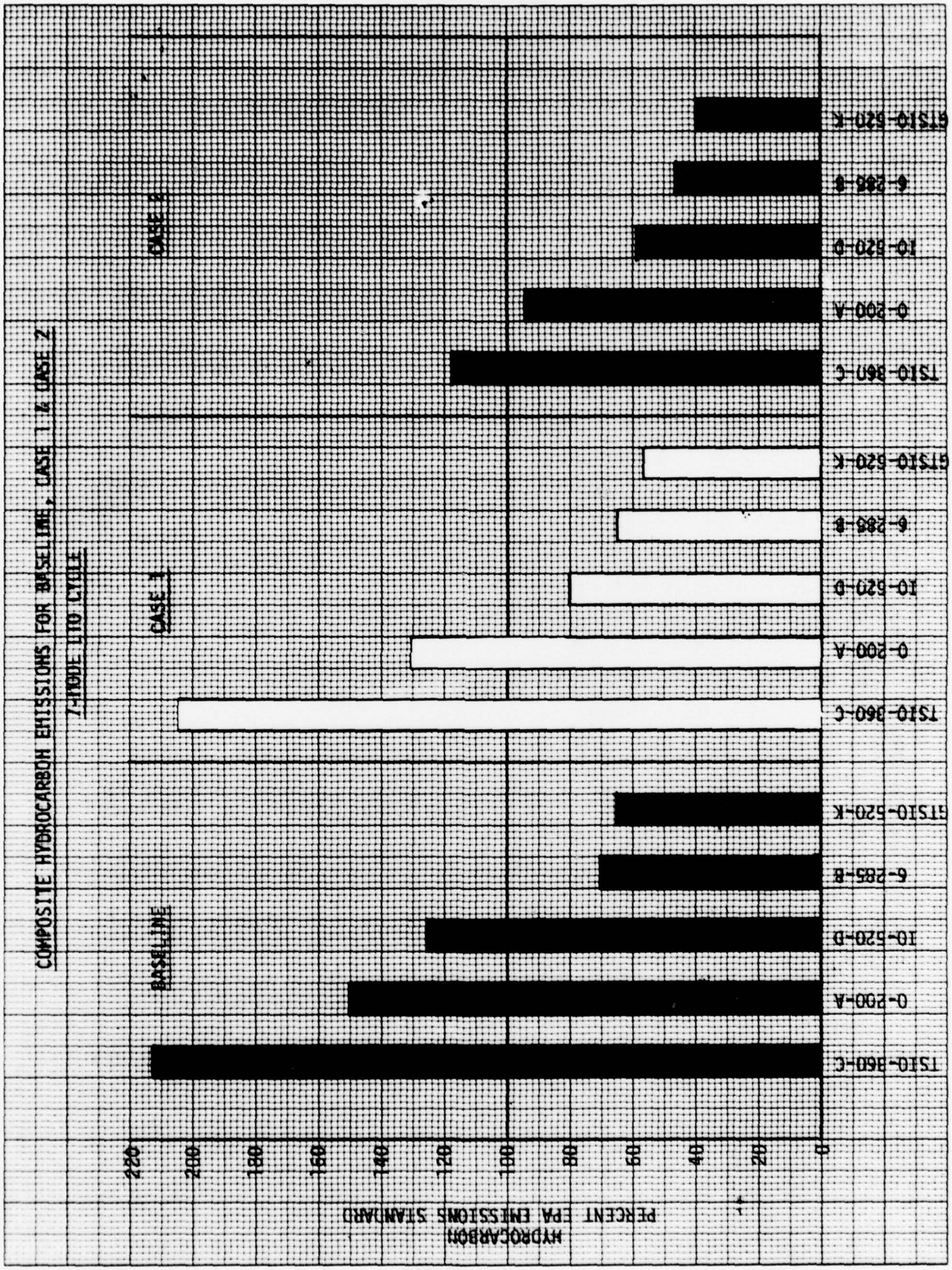

COMPOSITE HYDROCARBON EMISSIONS FOR BASELINE, CASE 1 & CASE 2
7-MODE LTO CYCLE
BASELINE
CASE 1
CASE 2
HYDROCARBON
PERCENT EPA EMISSIONS STANDARD
0
20
40
60
80
100
120
140
160
180
200
220
TSIO-360-C
O-200-A
IO-520-D
6-285-B
GTSIO-520-K
TSIO-360-C
O-200-A
IO-520-D
6-285-B
GTSIO-520-K
TSIO-360-C
O-200-A
IO-520-D
6-285-B
GTSIO-520-K

FIGURE 6-2

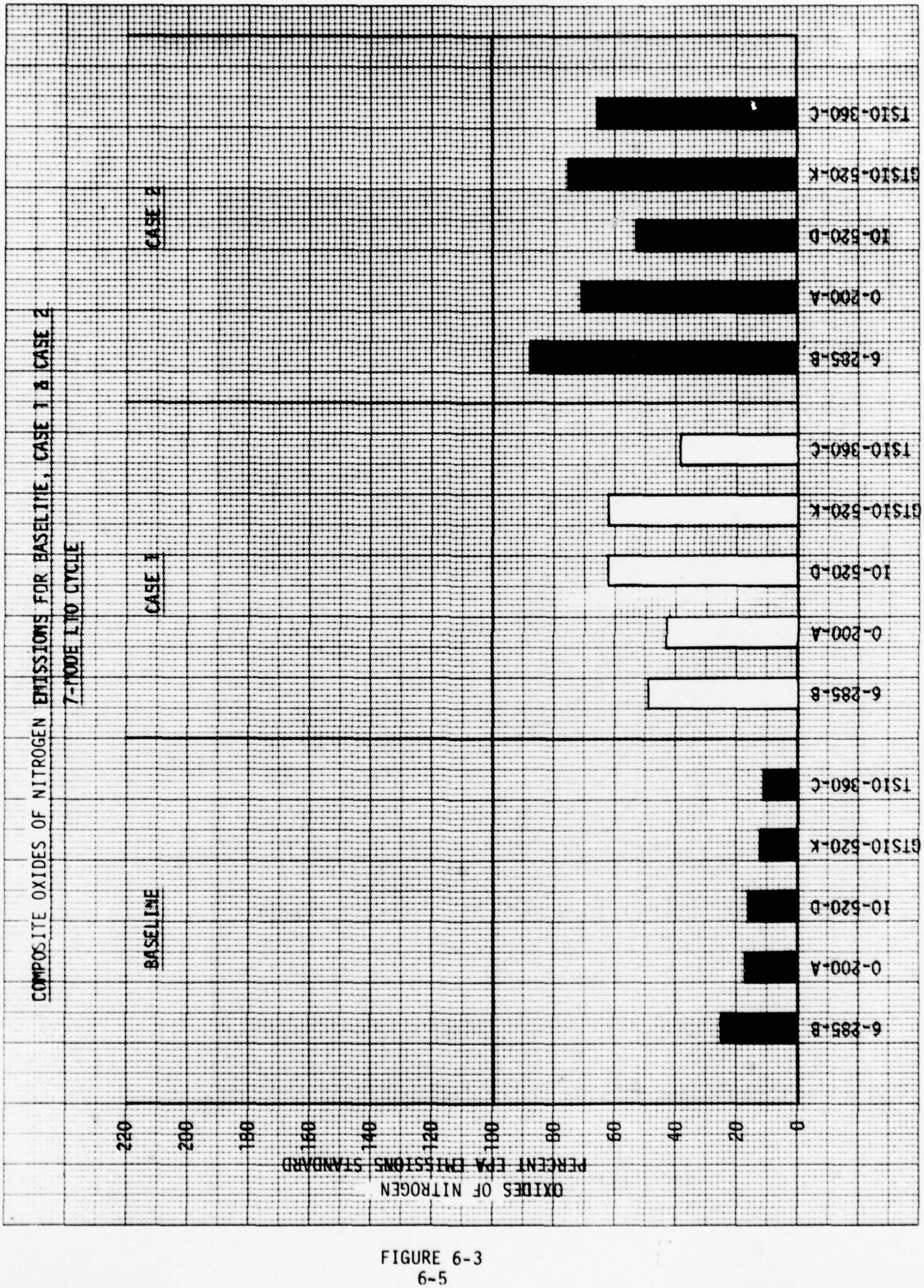
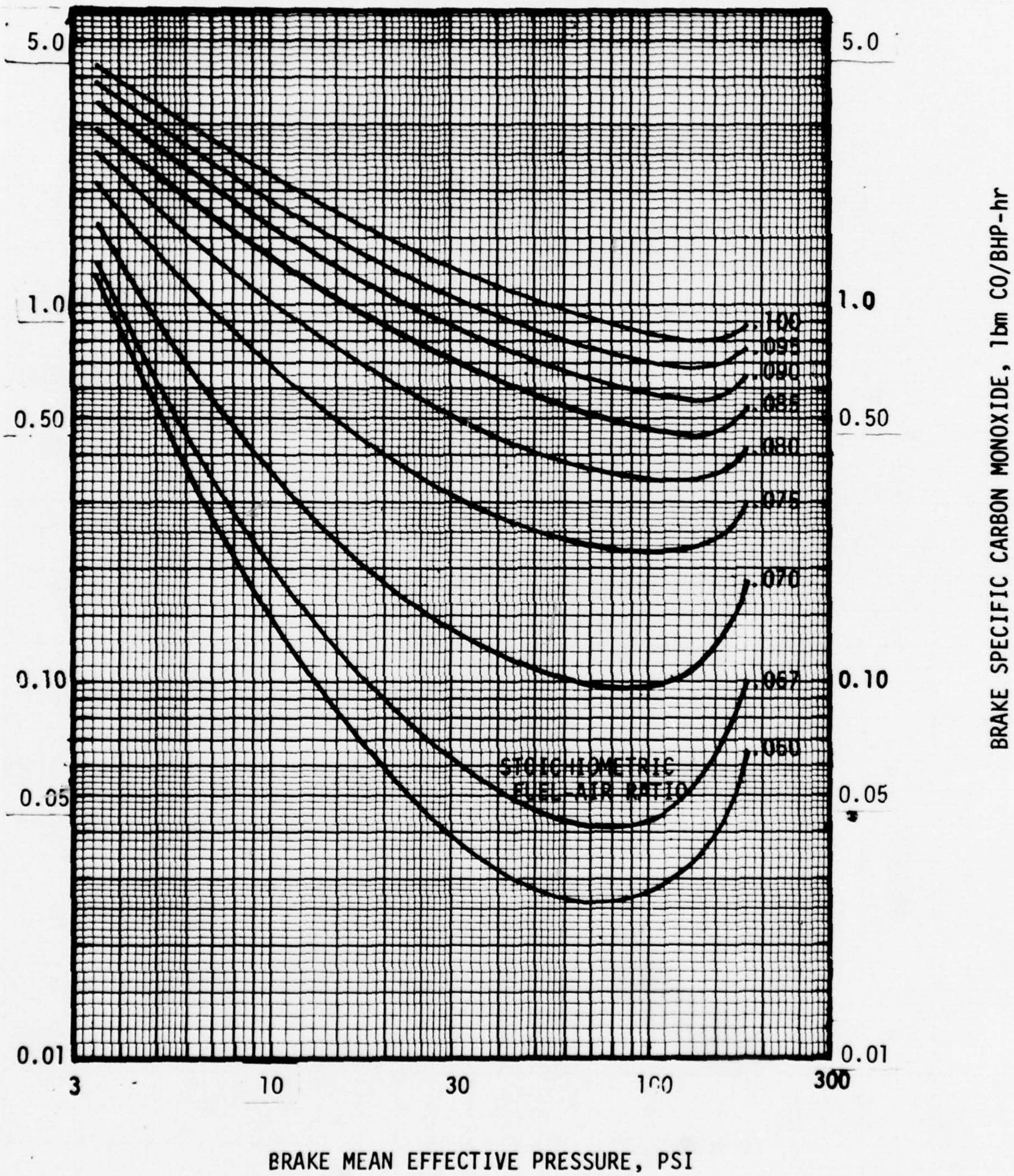

COMPOSITE OXIDES OF NITROGEN EMISSIONS FOR BASELINE, CASE 1 & CASE 2
7-MODE LTO CYCLE
BASELINE
CASE 1
CASE 2
6-285-B
0-200-A
10-520-D
GTSIO-520-K
TSIO-360-C
0
20
40
60
80
100
120
140
160
180
200
220
OXIDES OF NITROGEN
PERCENT EPA EMISSIONS STANDARD

FIGURE 6-3

FIGURE 6-4

BRAKE SPECIFIC CARBON MONOXIDE VS. BRAKE MEAN EFFECTIVE PRESSURE AT CONSTANT FUEL-AIR RATIO



7. CONCLUSIONS

The work accomplished on the five engines tested under Phase I of the NAFEC Contract DOT FA74NA-1091 points the way to further development efforts which must be undertaken in order to meet the requirements of the EPA exhaust emissions standards for aircraft piston engines. The conclusions presented here must be limited to the particular engines tested due to the unknown effect of engine production tolerance or time in service. Also, ambient temperature effects and variables arising from actual airframe installation must be taken into consideration in further emission work. The following conclusions were reached as a result of this exploratory effort.

1. None of the five engines tested can meet the 1980 EPA Standards within the specifications of their current Federal Aviation Administration Type Certificate operating conditions.

2. One engine (IO-520-D, S/N 559025) could meet the EPA Standards safely while operating within the current engine fuel flow specifications with manual leaning below the 75 percent power level and a near zero production tolerance band on fuel flow. To meet the Standards with acceptable fuel system tolerances would require the development of a fuel system with a new lean fuel schedule and engine recertification. Such a system might require improved cylinder head cooling and temperature compensation or fuel enrichment provisions for acceleration from low power.

3. One engine (TIARA 6-285-B, S/N 700106) could meet the Standards operating within cylinder head temperature and smooth transient operation limits if the fuel flow schedule were recertificated to a level below current fuel system lean limit specifications. The development of such a new fuel schedule might require improved cylinder head cooling and temperature compensation or fuel enrichment provisions for acceleration from low power.

4. All engines were well below the EPA Standard for NO_x, for BASELINE, CASE 1 and CASE 2 operation.

5. The O-200-A, GTSIO-520-K and TSIO-360-C engines would not meet the Standards even when operated at limits estimated to represent the leanest possible operation with acceptable cylinder head temperatures and transient performance.

6. The lean misfire limit at steady operating conditions is leaner than the limit of the ability of the engine to accelerate.

7. The Spindt method of calculating fuel-air ratio from exhaust products is not adequate for the purpose of data validation at the lower power modes (idle/taxi) due to the assumption of a constant value of 3.5 for the water-gas equilibrium parameter.

CONCLUSIONS (cont'd)

8. Flight tests indicated that the takeoff CASE 2 fuel flow was conservative for the naturally aspirated IO-520 / Cessna 210 installation.

9. Idle-Taxi CASE 2 fuel flows were unacceptable in the IO-520 / Cessna 210 installation due to the fuel system's inability to control fuel-air ratio with atmospheric temperature variations.

APPENDIX A. EXHAUST EMISSION CALCULATION PROCEDURE

TELEDYNE CONTINENTAL MOTORS

AIRCRAFT PISTON ENGINE
EXHAUST EMISSIONS CALCULATION PROCEDURE

I. BACKGROUND

The Federal Register, Volume 38, Number 136, Part II, dated July 17, 1973, sets forth the requirements for the control of air pollution from all aircraft and aircraft engines. Subparts E and I, and Appendix B deal with the requirements for compliance with the law regarding exhaust emissions from aircraft piston engines.

The exhaust emission test is designed to measure hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x) concentrations (percent or parts per million by volume) and determine mass emissions through calculations during a simulated aircraft landing-takeoff (LTO) cycle.

The calculations required to convert exhaust emission concentrations (raw emissions measurements) into mass emissions is the subject of this discussion.

II. THE COMBUSTION EQUATION

The chemical equation for the combustion of a hydrocarbon fuel in air can be represented symbolically by:

FUEL + AIR ⟶ PRODUCTS OF COMBUSTION

To be able to deal mathematically with the combustion equation it must be written in a form such that the coefficients, representing the quantities of each constituent, are known by virtue of measurement or are calculable using the principles of mass conservation or chemical equilibrium.

The combustion equation used as the basis for the emissions calculations is:

$$(M_F) \cdot \overbrace{C_x H_y}^{\text{Fuel}} + (M_a)\,[O_2 + \overbrace{(3.72744)\,N_2 + (0.04451)Ar]}^{\text{Dry Air}} + (M_w) \cdot \overbrace{H_2O}^{\text{Atmospheric Humidity}} \longrightarrow$$

$$\longrightarrow (M_1) \cdot H_2O + (M_2) \cdot CO_2 + (M_3) \cdot CO + (M_4) \cdot NO + (M_5) \cdot O_2 +$$

$$+ (M_6) \cdot C_p H_q + (M_7) \cdot H_2 + (M_8) \cdot N_2 + (M_9) \cdot Ar + (M_{10}) \cdot NO_2 +$$

$$+ (M_{11}) \cdot C$$

Where, M_i is the number of lbm-moles of the i^{th} constituent. One lbm-mole (Pound-mass mole) of a substance is a quantity of that substance in pounds-mass, numerically equal to the molecular weight of the substance in atomic mass units. One lbm-mole of water (H_2O), therefore, would have a mass of (2)(1.008) + 16 = 18.016 lbm.

$C_x H_y$ - a pure hydrocarbon fuel containing x atoms of carbon and y atoms of hydrogen in each molecule.
O_2 - Oxygen
N_2 - Nitrogen
A_r - Argon
H_2O - Water (Vapor)
CO_2 - Carbon dioxide
CO - Carbon Monoxide
NO - Nitric Oxide
NO_2 - Nitrogen Dioxide
$C_p H_q$ - Unburned hydrocarbon exhaust product containing p atoms of carbon and q atoms of hydrogen in each molecule.
H_2 - Hydrogen
C - Solid Carbon

Examining each constituent of the equation, it is necessary to determine what can be measured, what can be calculated and what assumptions must be made in order to calculate mass emissions values of HC, CO and NO_x.

III. FUEL AND AIR

We have represented the fuel, $C_x H_y$, as a pure hydrocarbon molecule. In reality, gasoline is a blend of many hydrocarbon products of refined crude oil and contains, in addition, antiknock agents such as tetraethyl lead, deposit modifiers, antioxidants, detergents, antirust agents, dyes and anti-icing agents which contain elements other than hydrogen and carbon. These other elements are ignored in the combustion equation as they are deemed negligible. The fuel molecule, $C_x H_y$ then is representative of a nominal or average hydrocarbon molecule with a ratio of hydrogen to carbon atoms of y/x. Although the actual values of y and x for the gasoline varies considerably and no specific values can be assigned to them in our simplified fuel molecule, the ratio of hydrogen to carbon atoms in 100/130 octane aviation gasoline can be measured and remains relatively constant at a value of about 2.125 (see Appendix H).

Likewise, the unburned hydrocarbon constituent in the exhaust may contain several species of hydrocarbons, but a ratio of q/p of 1.85 has been suggested to represent the average ratio of hydrogen to carbon in the exhaust hydrocarbon pollutant. This value, however, for the purpose of this analysis will be considered unknown.

The fuel flow is measured using a COX Vortex Flowmeter, Model #4271.

At TCM, airflow is measured by a Merriam laminar flowmeter which gives a linear relationship between mass flow and pressure drop, and compensates for temperature and pressure. The total mass flow measured includes the atmospheric humidity.

Humidity is calculated from measured values of wet and dry bulb temperatures and is given in terms of pounds-mass of water vapor per pound-mass of dry air.

IV. PRODUCTS OF COMBUSTION

The products of combustion as shown in the combustion equation are again simplified in that the non-hydrocarbon fuel additives are ignored.

The exhaust constituents which are measured include CO_2, CO, NO, NO_2, O_2 and $C H_{q/p}$. The constituents which are known, a priori, are Ar and N_2.

Those constituents which are not measured are C, H_2 and H_2O.

The formation of solid carbon, C, is the result of rich combustion of fuel (fuel burned in the presence of insufficient air) and to a varying extent, depending on engine age and condition, the burning of the oil lubricant entering the combustion chamber along the piston rings or valve guides. Chemical equilibrium calculations have shown that below fuel-air equivalence ratios of about 3.0 (fuel-air ratio of 0.20), solid carbon as a product of combustion is negligible compared to the remainder of the gaseous products. Aircraft piston engines do not normally run at overall equivalence ratios over 2.0 (fuel-air ratio of 0.13). The chemical equilibrium calculations, however, assume homogeneity of the fuel-air mixture. The lack of perfect mixture uniformity in a real engine would lead to some production of solid carbon due to localized rich mixtures within the combustion chamber.

At the present time solid carbon is not measured and is assumed for calculation purposes to be negligible. There is currently no equipment available to measure solid carbon production on a real-time basis.

Free hydrogen (H_2), which is present in the exhaust products in small, but significant quantities, is also not measured. Real-time measurement equipment for H_2 is available.

While there are systems on the market which will measure water (H_2O) vapor content in the exhaust, they are expensive. Calculative procedures are available to estimate the quantity of water vapor in the exhaust.

Table A-1 outlines the equipment currently used by TCM to determine those exhaust products which are measured.

TABLE A-1

EXHAUST PRODUCT	MEASURING INSTRUMENT	METHOD USED BY MEASURING INSTRUMENT
CO	Beckman Model 864 (NDIR)	Measurement of differential absorption of infra-red light.
CO_2	Beckman Model 864 (NDIR)	Measurement of differential absorption of infra-red light.
NO, NO_2	Beckman Model 951 H(CL)	$NO + O_3 \rightarrow NO_2$ + Light. Measurement of light intensity due to reaction.
O_2	Scott Model 150	Measures the effect of paramagnetic oxygen in gas sample on a magnetic field.
$C_p H_q$	Scott Model 215 (FID)	Measures effect on electrostatic field of ionized hydrogen and carbon from gas sample.

V. BALANCING THE COMBUSTION EQUATION

By the principle of conservation of mass we know that the atomic quantities introduced into the engine induction system must also be present in the exhaust even though they are rearranged into different molecules by the combustion chemical reaction. Hence, all the carbon atoms entering the engine in the form of hydrocarbon fuel molecules must be present in the exhaust in the form of CO, CO_2 and $C_p\ H_q$. This atom-balancing technique provides us with a system of equations by which we may solve for unknown quantities.

Going back to the original combustion equation, we eliminate solid carbon, C and nitrogen dioxide, NO_2 (since the NO_x constituent was measured in terms of equivalent NO in parts per million), we then divide each molar value on both sides of the equation by the sum of the molar values on the right hand side. The equation then becomes,

$$(m_f) \cdot C_x\ H_y + (m_a)\ [O_2 + (3.72744)\ N_2 + (0.04451)\ Ar] + (m_w) \cdot H_2O \longrightarrow$$

$$(m_1) \cdot H_2O + (m_2) \cdot CO_2 + (m_3) \cdot CO + (m_4) \cdot NO + (m_5) \cdot O_2 +$$

$$(m_6) \cdot C_p\ H_q + (m_7) \cdot H_2 + (m_8) \cdot N_2 + (m_9) \cdot Ar$$

$$\text{Where } m_i = \frac{M_i}{M_1 + M_2 + M_3 + M_4 + M_5 + M_6 + M_7 + M_8 + M_9}$$

Thus, every molar coefficient on the right hand side of the equation is now expressed in mole fractions such that,

$$m_1 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7 + m_8 + m_9 = 1.0$$

This is done for convenience and the reason for it will be demonstrated later.

The nine products of combustion represent an estimated 99.998% of the chemical composition of an equilibrium mixture at exhaust gas temperatures below 3000°R.

An oxygen balance results in Equation (1):

$$(1) \quad 2\ m_a + m_w = m_1 + 2m_2 + m_3 + m_4 + 2m_5$$

$$\text{or} \quad m_1 = 2\ m_a + m_w - 2\ m_2 - m_3 - m_4 - 2\ m_5$$

A carbon balance gives Equation (2):

$$(2) \quad x \cdot m_f = m_2 + m_3 + p \cdot m_6$$

$$\text{or} \quad m_f = \frac{m_2 + m_3 + p \cdot m_6}{x}$$

Since our measurement of $C_p H_q$ is in parts per million carbon equivalent we can represent $C_p H_q$ as $CH_{q/p}$. Equation (2) then becomes:

$$(2) \qquad m_f = \frac{m_2 + m_3 + m_6}{x}$$

The remaining atomic balances are as follows:

(3) Hydrogen Balance; $y \cdot m_f + 2m_w = 2m_1 + \frac{q}{p} \cdot m_6 + 2m_7$

(4) Nitrogen Balance: $(3.72744)\ (2)\ m_a = m_4 + 2\ m_8$

(5) Argon Balance: $(0.04451)\ m_a = m_9$

VI. THE WATER CORRECTION FACTOR

Since CO, CO_2 and O_2 are measured on a dry volumetric basis (the water vapor being removed from the exhaust sample before measurement), and HC and NO are measured on a wet volumetric basis, we must determine the amount of water vapor removed from the dry sample in order to correct all measured values to either a dry or a wet volumetric basis for calculative purposes. In doing this we are solving for one of the unknowns - m_1 (H_2O).

We can define the fuel to dry air mass ratio as,

$$(6) \qquad \frac{f}{A} = \frac{m_f\ (12.011\ x + 1.008\ y)}{m_a\ (138.2689)}$$

Where,

$(12.011\ x + 1.008\ y)$ = fuel molecular weight

and, 138.2689 = pounds-mass of air.
per lbm-mole of oxygen

The specific humidity, or water vapor to dry air mass ratio is,

$$(7) \qquad \frac{W}{A} = \frac{m_w\ (18.016)}{m_a\ (138.2689)}$$

By substituting Equations (2), (6) and (7) into Equation (1) and rearranging the terms we have,

$$(8) \qquad m_1 = \left[2 + 7.67478\ \frac{W}{A}\right]\left[\frac{(m_2 + m_3 + m_6)\ (12.011 + 1.008\ \frac{y}{x})}{138.2689\ (f/A)}\right]$$

$$-2\ m_2 - m_3 - m_4 - 2\ m_5$$

For clarity Equation (8) may be rewritten using chemical symbols to represent the mole fraction for each constituent,

(9) $H_2O = \left[2 + 7.67478\ \frac{W}{A}\right] \left[\frac{(CO_2 + CO + HC)\ (12.011 + 1.008\ \frac{y}{x})}{138.2689\ (f/A)}\right]$

$-2\ CO_2 - CO - NO - 2O_2$

Equation (9) then represents the total water vapor (humidity plus water of combustion) contained in the exhaust gas with each constituent measured on a wet basis.

Defining the water correction factor as,

(10) $$C_w = 1.0 - H_2O$$

we can convert the entire Equation (9) to dry basis measurements by dividing by $(1.0 - H_2O)$,

(11) $$\frac{H_2O}{1-H_2O} = \left[2 + 7.67478\ \frac{W}{A}\right]\left[\frac{(CO_{2\ dry} + CO_{dry} + \frac{HC_{wet}}{1-H_2O})(12.011 + 1.008\ \frac{y}{x})}{138.2689\ (f/A)}\right]$$

$$-2\ CO_{2\ dry} - CO_{dry} - \frac{NO_{wet}}{1-H_2O} - 2\ O_{2\ dry}$$

where, $CO_{2\ dry} = \frac{CO_{2\ wet}}{1 - H_2O}$, etc.

The solution to Equation (11) may be obtained iteratively by assuming a value for H_2O on the right hand side of the equation, solving for H_2O on the left hand side, using this new value for H_2O on the right hand side and repeating the process until satisfactory agreement has been obtained between the assumed and calculated values. Using this scheme, convergence is obtained usually within four iterations.

A more expansive chemical equilibrium calculation was made over the normal range of fuel air ratios, considering the products of combustion to include; C, A, CO, CO_2, H_2, H_2O, N_2, O_2, O, OH, H, NO, N, NH_3 and CH_4. The maximum error determined in the calculation of water vapor using our abbreviated product of combustion equation was less than one-half of one percent.

The solution to the wet correction factor then was obtained by using five equations ((1), (2), (6), (7) and (10)) involving five unknowns; m_a, m_w, m_l, m_f and C_w. The assumptions made in order to effect a solution to the water correction factor are:

1. The combustion equation represents all of the elemental constituents involved in the actual combustion process.

2. The ratio of hydrogen to carbon atoms for all 100/130 octane aviation gasolines remains constant at (y/x).

While there are similar methods which can be used to calculate the water correction factor, it is believed that this method involves the use of the least number of assumptions leading to the most accurate estimate of C_w based on the quantities currently being measured.

The absolute value of the water correction factor has two limits defined by the combustion equation. Its maximum value cannot be greater than 1.0 and its minimum value is set by the hydrogen to carbon ratio of the fuel and the humidity present in the induction air.

In terms of the mole fraction of water present in the exhaust, it can be shown from Equation (9), that for complete combustion at the stoichiometric value of fuel-air ratio, the mole fraction of water contained in the exhaust gas is a maximum (water correction factor is a minimum since $C_W = 1.0 - H_2O$).

For complete combustion the products of combustion are CO_2, H_2O and N_2. Equation (9) then becomes;

$$H_2O_{max} = \frac{\left(\frac{y}{x}\right) + 15.34956 \left(\frac{W}{A}\right) \left[1.0 + 0.25 \frac{y}{x}\right]}{2.88669 \left(\frac{y}{x}\right) + 9.54676}$$

As an additional check on data accuracy, the calculated value of H_2O is compared with H_2O_{max}. In the data reduction computer program, when the calculated H_2O is greater than H_2O_{max}, the mole fraction of water vapor is set to the theoretical maximum value. The effect on the mass emissions values by using this procedure is only a fraction of one percent.

VII. CALCULATION OF MASS EMISSION VALUES

As mentioned previously the raw emissions are measured on a volumetric basis in percent or parts per million. In order to determine the emissions based on the requirements of the EPA Standards, these volumetric values must be converted to volumetric flow rate and then to mass flow values in accordance with Equation (12).

(12) pollutant mass emission rate = exhaust volumetric flow rate • pollutant volumetric concentration • pollutant density

For this equation, the pollutant densities are specified in the Federal Register at a standard pressure and temperature of 760 mm H_g and 68°F. The values of pollutant volumetric concentrations (CO, HC, NO_x), are measured, and in order to calculate the mass emission rates the exhaust volumetric flow rate must be known.

The EPA Standards state that the exhaust volumetric flow rate "shall be calculated in accordance with good engineering practices".

Two methods are used by TCM to calculate the exhaust volumetric flow rate - one is called the Exhaust Volume Method and the other, the Carbon Balance Method.

The basis for the Exhaust Volume Method is in the calculation of the exhaust volumetric flow rate at the standard pressure and temperature of 760 mm H_g and 68°F, using the assumption that the exhaust gas follows the ideal gas equation of state.

$$(13) \quad \dot{V}_{EXH} = \frac{R\,\dot{m}\,T}{M_{EXH}\;P} = \frac{R\,(f + A')\,T}{M_{EXH}\;P}$$

where,
- $\dot{V}_{EXH}$ - exhaust volumetric flow rate, ft^3/hr
- R - universal gas constant 1545.33 $\frac{ft\text{-}lbf}{lbm\text{-}mole^\circ R}$
- $\dot{m}$ - total exhaust gas mass flow (also equal to total induction mass flow of fuel and air by principle of mass conservation), lbm/hr
- T - absolute temperature, 528° R (68°F)
- M_{EXH} - exhaust gas molecular weight
- P - exhaust pressure, 2116 $\frac{lbf}{ft^2}$ (760 mm Hg)
- f - fuel mass flow, lbm/hr
- A' - humid air mass flow, lbm/hr

In Equation (13), R, T and P are given values and $\dot{m}$ is measured. The value of the exhaust gas molecular weight can be calculated from exhaust products,

$$(14) \quad M_{EXH} = \sum m_i\, M_i$$

where, M_{EXH} is the "apparent molecular weight" of the exhaust gas. M_i is the molecular weight of each constituent and m_i is the mole fraction of each constituent which can be determined from measured concentrations and solution of Equations (2) through (7). Solution of Equation (14) further requires an assumption of exhaust hydrocarbon hydrogen to carbon ratio, q/p. Studies have indicated however that extremely unreasonable values of calculated fuel-air ratio are obtained when the sum of the exhaust gas mole fractions are constrained to unity.

Therefore, the method used by TCM to compute the exhaust gas molecular weight is Equation (14) where each of the individual mole fractions, m_i, of the exhaust gas constituents are determined by simultaneous solution of equations (2) through (7). One other method was used where the exhaust molecular weight was obtained from chemical equilibrium considerations. This method was rejected on the basis that chemical equilibrium does not exist in the exhaust products and the error becomes large for low power engine operation. The calculation of mass emissions of carbon monoxide, for example, would be as follows, by substituting Equation (13) into Equation (12).

$$(15) \quad \dot{m}_{CO} = \left[\frac{R\,(f + A')\,T}{M_{EXH}\;P}\right] \cdot \left[\rho_{CO}\right] \cdot \left[CO\right]$$

Since, by the ideal gas assumption,

$$(16) \quad \rho_{CO} = \frac{M_{CO}\;P}{RT}$$

Substitution of Equation (16) into (15) yields,

$$\dot{m}_{CO} = \left[\frac{R\ (f + A')\ T}{M_{EXH}\ \ P}\right] \bullet \left[\frac{M_{CO}\ P}{RT}\right] \bullet [CO]$$

or,

$$(17) \quad \boxed{\dot{m}_{CO} = \left(\frac{M_{CO}}{M_{EXH}}\right) (f + A')\ (CO)}$$

where,
- $\dot{m}_{CO}$ - mass emission rate of CO, lbm/hr
- M_{CO} - molecular weight of CO, 28.011 $\frac{lbm}{lbm\text{-}mole}$
- M_{EXH} - exhaust gas molecular weight $\frac{lbm}{lbm\text{-}mole}$
- $(f + A')$ - total induction mass flow rate, $\frac{lbm}{hr}$
- CO - wet volume fraction of CO in exhaust

The Carbon Balance Method of calculating exhaust volumetric flow rate is also used by TCM. This method provides a cross-check on the Exhaust Volume Method and is the same method used in the calculation of turbine engine emissions.

The Carbon Balance Method is believed to be the more accurate, as measurement of airflow, A, and estimation of exhaust gas molecular weight, M_{EXH}, are not required. The Carbon Balance Method accounts for all the carbon atoms in the combustion equation, and by conservation of mass, the carbon introduced into the engine in the molecular form of fuel must be accounted for in the carbon-containing exhaust product molecules - CO, CO_2, $C_p\,H_q$.

As with the Exhaust Volume Method, the assumption is made that the ideal gas equation of state applies.

The derivation of the Carbon Balance Method is as follows:

From Equation (2), the carbon balance equation,

$$m_f = \frac{m_2 + m_3 + m_6}{x} = \frac{\text{moles of fuel}}{\text{moles of wet exhaust}}$$

The volumetric flow rate of the exhaust can then be calculated as follows,

$$(18) \quad \dot{V}_{EXH} = \frac{\dot{m}_{EXH}}{\rho_{EXH}} = \frac{\dot{M}_{EXH}\ \ M_{EXH}}{\rho_{EXH}}$$

where,
- $\dot{M}_{EXH}$ - molar flow rate of exhaust, $\frac{lbm\text{-}moles}{hr}$
- M_{EXH} - molecular weight of exhaust, $\frac{lbm}{lbm\text{-}mole}$
- ρ_{EXH} - exhaust gas density, $\frac{lbm}{ft^3}$

We define,

(19) $$\dot{M}_{EXH} = \frac{f}{m_f\ M_f}$$

where, f - mass fuel flow, lbm/hr

M_f - molecular weight of fuel, lbm / lbm-mole

m_f - (from carbon balance Equation (2)) moles of fuel/moles of wet exhaust

From the ideal gas equation of state,

(20) $$\frac{M_{EXH}}{\rho_{EXH}} = \frac{RT}{P}$$

Substituting Equations (19) and (20) into (18) we get,

(21) $$\dot{V}_{EXH} = \frac{f}{m_f\ M_f}\left(\frac{RT}{P}\right)$$

Substituting this result into Equation (12) and using carbon monoxide as an example,

(22) $$\dot{m}_{CO} = \frac{f}{m_f\ M_f}\left(\frac{RT}{P}\right)\cdot\left(\rho_{CO}\right)\cdot\left(CO\right)$$

Since the density of CO, (ρ_{CO}) by ideal gas consideration is,

(23) $$\rho_{CO} = M_{CO}\left(\frac{P}{RT}\right)$$

and the molecular weight of the fuel is,

(24) $$M_f = x\ (12.011 + 1.008\ \frac{y}{x}\ )$$

We can substitute Equations (23), (24) and (2) into Equation (22) to obtain,

(25) $$\boxed{\dot{m}'_{CO} = \frac{f\ M_{CO}\ \ CO}{\left[12.011 + 1.008\ \frac{y}{x}\right]\ (HC + CO + CO_2)}}$$

Note that the value, x, in Equation (24) cancels with the x in Equation (2) so that it is not necessary to know the molecular form of the fuel, but only the H/C ratio, y/x.

This method is attributable to Stivender (see SAE Paper 710604) and has the advantage of producing an exhaust volumetric flow rate calculation independent of measured air flow which is a source of some probable error in the Exhaust Volume Method. It is instructive to look at the difference between these two methods. In order to do this we can take the ratio of Carbon Balance to Exhaust Volume mass flow values for CO using Equations (25) and (17).

$$(26) \qquad \frac{\dot{m}'_{CO}}{\dot{m}_{CO}} = \frac{(f/A)\ (M_{EXH})}{(12.011 + 1.008\ \frac{y}{x})\ (HC + CO + CO_2)\ (1.0 + \frac{W}{A} + \frac{f}{A})}$$

It has been found that this ratio will be unity when the water correction factor has not been artificially set to its minimum value (see discussion of water correction factor on page A-5). Since the water correction factor is a function of all the variables in Equation (9), then errors in these values would cause the value of the wet correction factor to vary. If the wet correction factor error is large causing its value to be too low then it will be set to a reasonable minimum value by the data reduction computer program, and the ratio of Carbon Balance to Exhaust Volume will deviate from unity.

The Carbon Balance and Exhaust Volume comparison, using the minimum wet correction factor criterion, provides a check on the data which is only of value when the wet correction factor is unreasonably low. The use of data validity checks is discussed further in Appendix B, page B-4. The Carbon Balance Method is the preferred method used in this report providing a convenient means for the measurement of exhaust emissions in a field survey or flight test situation, where the measurement of air flow would be difficult.

VIII. CALCULATION OF FUEL-AIR RATIO

The Exhaust Emissions Standards require a check on accuracy of measured data which involves the calculation of fuel-air ratio from exhaust gas constituents. This calculated fuel-air ratio must be within $\pm$ 5.0% of the measured fuel-air ratio in order for the test to be valid. (See Part 87.96, subparagraph (b) of the Regulation).

An example of this method is given in the text "Internal Combustion Engines and Air Pollution" by E. F. Obert, page 353. The method is simple and reliable if the molecular form of the fuel and exhaust hydrocarbons is known, that is if we know the values x, y, p and q in $C_x H_y$ and $C_p H_q$.

To this point in the analysis we have scrupulously avoided assumption of these values by using equations in the form such that only the value of y/x must be known. This value has been measured and thus eliminates a possible source of error.

An alternative method for calculating fuel-air ratio has been developed by R. S. Spindt in SAE Paper 650507 which requires the use of ratios including y/x, eliminating the assumption of fuel molecular form, avoiding the errors encountered by previous investigators.

A subsequent SAE Paper (660118) entitled "An Evaluation of Techniques for Measuring Air-Fuel Ratio" by L. C. Broering, Jr., shows that the Spindt Method is accurate to within $\pm$ 5,0% at a fuel-air ratio of 0.067. This inclusion, however, was based on a limited data base using an automotive engine.

The derivation of the Spindt Method will not be covered here except to say that the required input values are O_2, CO, CO_2, HC, y/x and the assumption of the water-gas equilibrium parameter, K_p. Equation (27) is the Spindt Equation.

$$(27) \quad \frac{f}{A} = \frac{1.0}{FB\left[(11.492)\,FC\left(\frac{1.0 + E/2 + D}{1 + E}\right) + \frac{120\,(1-FC)}{(K_p + E)}\right]}$$

where,

f/A	-	calculated fuel-air ratio
FB	-	$(CO + CO_2)/(CO + CO_2 + HC)$
FC	-	(12.011)/(12.011 + 1.008 y/x), the fraction of carbon in fuel, $C_x\,H_y$
E	-	CO/CO_2
D	-	O_2/CO_2
K_p	-	$(H_2O)\cdot(CO)/(H_2)\cdot(CO_2)$

The water-gas equilibrium parameter comes from the chemical equation,

$$(28) \quad H_2 + CO_2 \rightleftharpoons H_2O + CO$$

where,

$$(29) \quad K_p = \frac{(H_2O)\ (CO)}{(H_2)\ (CO_2)}$$

Basically, chemical equilibrium dictates through the "mass action law" that when a chemical system is in equilibrium at a constant temperature the mole fractions of the reactants (H_2 and CO_2) and products (H_2O and CO) take on values such that the value K_p in Equation (29) remains constant.

Another way to look at this phenomenon is that in Equation (28) the rate of change of $H_2 + CO_2$ into H_2O + CO is equal to the rate of change of H_2O + CO into H_2 and CO_2.

The basis for this assumption in the combustion process is that as the exhaust gases expand and cool in the expansion and exhaust strokes, the rates of reaction decrease to a very small value due to the sudden decrease in temperature and the water-gas equilibrium reaction is essentially "frozen" at the higher temperature values. This assumption is invalid in that the temperatures of the exhaust gases at the start of the expansion stroke vary considerably with engine operating mode and fuel-air ratio. For the most part, at least at the higher power modes of the aircraft emissions cycle (takeoff, climb, approach), TCM has found that measured values of fuel-air ratio agree to within the required $\pm$ 5.0% of those calculated by the Spindt Method.

Having taken all reasonable steps necessary to assure the accuracy of the data collected from the five different engines investigated to date, the conclusion has been reached that the Spindt Method is not accurate to within ± 5.0% at low power modes (taxi/idle). In addition, it has been determined that the requirement that measured and calcualted fuel-air ratios be within ± 5.0% is not sufficient to prove that the measured emissions data is accurate.

A thorough investigation of the source of error in the Spindt Method led to the discovery that the assumption of a constant value of the water-gas equilibrium parameter is in error. Spindt used a value of 3.5 as it best fit his data. Indications from TCM data show that the value of K_p may vary from 2.1 to 4.4. A specific value of the water-gas equilibrium constant may be applicable in comparing similar engine operating conditions, but in general it would not be valid to assume it as a constant for all modes of operation.

When using the Spindt Method for calculating fuel-air ratio with a constant value for K_p, it seems inappropriate to eliminate a lower power data point where calculated and measured fuel-air ratios are not within the prescribed ± 5.0% tolerance.

Unless another calculative procedure is developed with the promise of greater accuracy in predicting fuel-air ratios at lower power modes, it seems unlikely that the requirements of data validity can be met.

APPENDIX B. DATA REDUCTION PROGRAM OUTPUT FORMAT

DATA REDUCTION PROGRAM OUTPUT FORMAT

The TCM exhaust emissions data reduction computer program has used the same basic calculative procedures since the start of the Contract. Many modifications have been made to expand the capability of the program and the output format has evolved into its present form encompassing more engine operation data.

The single-page format used in this report was developed especially for the report to eliminate data which is considered to be of only academic value, keeping the report volume to a minimum. The information normally occurring on the second page of output deals with the Exhaust Volume method of calculating mass emissions and a detailed exhaust gas composition calculation in mole fractions of each exhaust gas constituent. The essential information from these calculations is presented at the bottom of each page as "DIFF EV & CB RATE - PERCENT" (percent difference between the Exhaust Volume and Carbon Balance Methods of calculating mass emissions), and "SUM OF MOLE FRACTIONS" (the sum of the individual mole fractions of the exhaust gas constituents). The detailed calculation of these values is covered in Appendix A, EXHAUST EMISSIONS CALCULATION PROCEDURE.

In order to promote a better understanding of the information presented in the data reduction output format, a detailed explanation of each item, its origin and significance are given here.

Referring to Figure B-1, showing a typical data reduction run for the IO-520-D engine, the first line identifies the engine, engine serial number, test number, test condition, run numbers and test date. The second line gives general test data applicable to the entire page.

PBARO - Corrected barometric pressure, inches of mercury, absolute.

TDRY - Dry bulb temperature by which observed barometer reading was corrected, °F.

TWET - Wet bulb temperature, °F.

FUEL HYDROGEN-CARBON RATIO - The measured ratio of fuel hydrogen atoms to carbon atoms, 2.125 for all engines tested. Fuel used is Chevron 100/130 low lead avgas.

TAMB - Ambient temperature of open test cell, °F.

RATED HP - The nominal rated brake horsepower specified by the engine type certificate.

CID - The nominal engine displacement, cubic inches.

EXHAUST C-H FORMULA - Molecular formula of unburned hydrocarbons in the exhaust whose ratio of hydrogen to carbon is 1.85 as specified by Part 87.99 (e) (3) of the Federal Regulation.

H_2O IN AIR - The mass percent of water vapor in the humid air mixture as calculated from TWET and TDRY.

This program can handle the data from one to seven modes per page. Figure B-1 shows the results for a complete 7-mode NAFEC cycle. The first item of data is the RUN NUMBER. Each mode is uniquely described by its own run number and these numbers are assigned chronologically to each mode throughout the test series. The TIME IN MODE in munutes will always be shown as follows, corresponding to each mode number and name, for the NAFEC 7-mode LTO (Landing- Takeoff) cycle.

MODE NAME	MODE NUMBER	TIME IN MODE
IDLE (OUT)	1	1.0 min.
TAXI (OUT)	2	11.0
TAKEOFF	3	0.3
CLIMB	4	5.0
APPROACH	5	6.0
TAXI (IN)	6	5.0
IDLE (IN)	7	1.0
		TOTAL 27.3 min.

For a complete cycle, under the TOTAL column, the number 27.3 (minutes) will appear. On pages where an LTO cycle was not run, the TOTAL column will be blank as the calculated data for this column would have no practical significance.

The next item, FUEL FLOW - LB/HR, is the fuel flow for each mode as measured by a COX Model 129-212C Rotameter.

INDUCTION AIRFLOW - LB/HR was measured by either a Merriam 50MC2 Laminar Flowmeter or in the case of the O-200-A engine, a square edged orifice was used for the Idle and Taxi Modes and a Bailey Variable Orifice meter was used for the higher power modes. Due to the inaccuracies of the Bailey device, rerun testing of the O-200-A used an Autotronics 100-200SF turbine-type flow transducer. The flow value includes ambient humidity.

Raw exhaust emissions were measured as follows:

HC (parts per million as carbon, wet) Scott Model 215(FID)
NO_x (parts per million, wet) Beckman Model 951H(CL)
CO, CO_2 (volumetric percent, dry) Beckman Model 864(NDIR)
O_2 (volumetric percent, dry) Scott Model 150 (paramagnetic)

The WET CORRECTION FACTOR is a calculated value (see Appendix A) used to correct dry, CO, CO_2 and O_2 values to wet concentrations.

PROP TORQUE and PROP SPEED are reported where the torque is measured by a LeBow Torquemeter installed between the propeller flange and the propeller. In the case of a geared engine, the engine speed can be computed by multiplying the prop speed by the appropriate gear ratio; 2.0 for the Tiara 6-285-B, and 1.5 for the GTSIO-520-K.

The MFLD (manifold) PRESSURE is measured downstream of the throttle body and is reported in inches of mercury, absolute, dry. The term "dry" refers to the induction air pressure having been corrected for ambient air water vapor pressure to a value of 29.92 in. Hg absolute, dry.

The INDUCTION AIR TEMP is the air temperature at the inlet to the engine. Its value varies from the ambient temperature, due to the air passing through a large blower and air pressure control valve on its way to the engine.

COOLING AIR TEMP and COOLING AIR DELTA P refer to the separate air supply system that provides cooling air across the engine cylinders. The pressure drop across the cylinder baffling is reported in inches of water. Cooling air is not normally supplied to the engine during low power modes. There is, however, sufficient convective cooling under these conditions. As a result, the cooling air temperature will be reported as 0.0 in the low power modes since it will have no significance.

The MAX CYL HEAD TEMP refers to the maximum cylinder head temperature. Although the maximum temperature does not necessarily occur at the same cylinder under all operating conditions, for consistency, the temperature reported here is from the same cylinder for all runs. This cylinder was chosen because it has the highest temperature at the most critical condition of maximum power.

The EXHAUST GAS TEMP is measured near the exhaust emissions sampling tube in the exhaust collector. Since the exhaust is well mixed at this point, this temperature represents a composite value for the engine exhaust.

INDUCTION FUEL-AIR RATIO, is that derived from measured fuel flow and dry air flow (corrected for humidity). The EQUIVALENCE RATIO is the fuel-air ratio divided by the stoichiometric fuel-air ratio. (Stoichiometric = 0.067 for the fuel hydrogen-carbon ratio used during these tests.) In the far right-hand TOTAL column in these two rows appear numbers which represent time-averaged (TA) fuel-air ratio and fuel-air equivalence ratio. These are the individual modal values multiplied by the fraction of total cycle time they occur and then summed over the entire cycle. The value of calculating a time-averaged equivalence ratio is that the emissions presented as a percent of the EPA Standard are also time-averaged over the cycle. In plotting a graph of these calculated numbers as a function of each other, general trends may be observed. If the data on the single-page output does not represent a complete 27.3 minute, 7-mode cycle, the TA column will be blank.

The OBSERVED POWER is calculated from the prop torque (observed value) and prop RPM, uncorrected for temperature or humidity. This value is inherently corrected for vapor pressure and barometric pressure as the induction air inlet to the engine is maintained at 29.92 in. Hg., absolute, dry.

The values for OBS BMEP (observed brake mean effective pressure) and OBS BSFC (observed brake specific fuel consumption) are calculated from measured quantities. The section of Figure B-1, entitled CARBON BALANCE MASS EMISSIONS, (see Appendix A for calculation procedure), gives the calculated values of HC, CO and NO_x for each mode (LB/HR), the brake specific emissions (LBM/BHP-HR), the mass per mode (LB), the total cycle mass per rated brake horsepower (LB/HP) and, finally the PERCENT OF EPA STANDARD. Again, if the data on the output sheet does not represent a 27.3 minute, 7-mode cycle, the TOTAL column will be left blank.

While the large part of NO_x emissions from these engines is composed primarily of NO, the chemiluminescent analyzer measures NO_x by converting NO_2 in the exhaust sample to NO. The NO is then converted to NO_2 using ozone in a reaction chamber. During this conversion some of the NO_2 (about 10%) becomes electronically excited and subsequently gives off light radiation which is measured by a photomultiplier tube. The measured light radiation is thus proportional to the mass rate of flow of total oxides of nitrogen (NO_x). In converting volumetric NO_x to mass emissions the molecular weight of NO_2 is used, which is in accordance with the EPA regulations.

The final rows of data on each sheet represent three cross-checks for the purpose of determining the relative validity of the data. For each mode a fuel-air ratio is calculated using the Spindt Method (see Appendix A). Comparing the calculated and measured fuel-air ratios gives an estimate of the accuracy of the fuel flow, air flow, O_2, CO , CO_2 and HC measurements. While it has been found that close agreement between measured and calculated fuel-air ratios is not sufficient to prove the accuracy of the data, large differences between the two values may indicate errors in measured values.

The difference between the Exhaust Volume (EV) and Carbon Balance (CB) mass emission rates is an additional indicator of data accuracy. If reasonable values of wet correction factor are obtained there is no difference between the Exhaust Volume and Carbon Balance methods and the difference value of 0.05 will be printed out (essentially, zero percent). Where values of emissions and/or measured fuel-air ratio result in unreasonable calculated values of wet correction factor (too low), the wet correction factor is artifically set at a minimum value (see Appendix A) and a number larger than 0.05 will appear in this row.

The last row, called SUM OF MOLE FRACTIONS, is the total of the calculated mole fractions of each of the individual exhaust gas constituents: N_2, H_2O, CO, CO_2, H_2, AR, O_2, HC and NO_x. Theoretically, this value must be equal to unity if the calculation procedure and measurement system accurately accounts for 100 percent of the exhaust products.

IO-520-D S/N 559025 TEST 14 LEAN 22 DEG BTC RUNS 96-102 03/26/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.262	83.00	49.00	2.1250	70.00	300.00	520.00	3.000 5.550	0.415

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	96.	97.	98.	99.	100.	101.	102.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.70	14.60	143.00	107.00	63.00	14.10	9.00	
INDUCTION AIR FLOW (W)	LB/HR	110.00	173.00	1750.00	1410.00	830.00	170.00	110.00	
HYDROCARBON CONC.	PPM-C W	35000.00	16500.00	1650.00	800.00	1200.00	18500.00	36000.00	
OXIDES OF NITROGEN CONC	PPM W	37.50	50.00	375.00	690.00	440.00	50.00	35.00	
CARBON MONOXIDE CONC.	PERCENT	3.95	6.50	7.20	5.15	6.20	7.00	4.20	
CARBON DIOXIDE CONC.	PERCENT	8.50	9.25	9.75	10.75	10.25	8.75	8.50	
OXYGEN CONC.	PERCENT	4.50	1.50	0.50	0.50	0.25	1.50	4.25	
WET CORRECTION FACTOR	--	0.88499	0.86719	0.86429	0.86268	0.85782	0.85782	0.88726	
PROP. TORQUE	FT-LB	17.00	40.00	530.00	492.00	255.00	40.00	17.00	
PROP. SPEED	RPM	800.00	1200.00	2850.00	2565.00	2480.00	1200.00	800.00	
MFLD PRESSURE	IN HG ABS DRY	14.30	12.70	28.75	27.70	18.00	12.90	14.50	
INDUCTION AIR TEMP	DEG F	64.00	65.00	73.00	76.00	75.00	73.00	73.00	
COOLING AIR TEMP	DEG F	0.0	0.0	79.00	78.00	79.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	2.00	2.00	2.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	322.00	310.00	460.00	440.00	358.00	310.00	320.00	
EXHAUST GAS TEMP	DEG F	515.00	680.00	1420.00	1385.00	1225.00	660.00	495.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07942	0.08474	0.08205	0.07620	0.07622	0.08329	0.08216	0.08083 TA
IND. F/A EQUIV. RATIO	--	1.19	1.27	1.23	1.14	1.14	1.25	1.23	1.21 TA
ENGINE OBSERVED POWER	HP	2.59	9.14	287.60	240.29	120.41	9.14	2.59	
OBS BMEP	PSI	4.93	11.60	153.70	142.68	73.95	11.60	4.93	
OBS BSFC	LBM/BHP-HR	3.360	1.597	0.497	0.445	0.523	1.543	3.476	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.05630	1.54284	1.56147	0.60829	0.52082	1.66490	2.13647	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.79409	0.16881	0.00543	0.00253	0.00433	0.18217	0.82505	
HC MASS / MODE	LB	0.03427	0.28285	0.00781	0.05069	0.05208	0.08325	0.03561	0.54656
HC MASS / RATED HP	LB/HP								0.00182
HC - PERCENT OF EPA STANDARD									95.89
CO EMISSION RATE *	LB/HR	4.14610	10.64021	118.88577	68.19676	46.59979	10.90935	4.46457	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.60112	1.16422	0.41337	0.28382	0.38701	1.19366	1.72411	
CO MASS / MODE	LB	0.06910	1.95070	0.59443	5.68306	4.65998	0.54547	0.07441	13.57715
CO MASS / RATED HP	LB/HP								0.04526
CO - PERCENT OF EPA STANDARD									107.76
NOX EMISSION RATE	LB/HR	0.00731	0.01550	1.17676	1.73971	0.63324	0.01492	0.00689	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00282	0.00170	0.00409	0.00724	0.00526	0.00163	0.00266	
NOX MASS / MODE	LB	0.00012	0.00284	0.00588	0.14498	0.06332	0.00075	0.00011	0.21801
NOX MASS / RATED HP	LB/HP								0.00073
NOX- PERCENT OF EPA STANDARD									48.45
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08078	0.08628	0.08252	0.07711	0.08076	0.08925	0.08272	0.08334 TA
DIFF. CALC & MEAS F/A	PERCENT	1.71	1.81	0.57	1.19	5.96	7.16	0.68	3.11 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.75	0.36	0.05	
SUM OF MOLE FRACTIONS		0.99528	1.00579	1.01037	0.99284	1.02091	1.01832	0.99166	

FIGURE B-1

APPENDIX C. 0-200-A TEST DATA

C-200-A S/N 251950 TEST 1 BASELINE - 28 DEG BTC RUNS 1-7 10/29/74

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.124	75.00	71.00	2.1250	78.43	100.00	201.00	3.000	5.550	1.513

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.80	9.40	41.20	41.20	25.00	9.30	3.80	
INDUCTION AIR FLOW (W)	LB/HR	37.45	95.00	551.00	551.00	270.00	94.00	35.65	
HYDROCARBON CONC.	PPM-C W	42000.00	7500.00	1250.00	1250.00	3500.00	8200.00	37000.00	
OXIDES OF NITROGEN CONC	PPM W	15.00	30.00	575.00	575.00	100.00	25.00	15.00	
CARBON MONOXIDE CONC.	PERCENT	9.70	10.40	8.20	8.20	10.20	10.50	10.10	
CARBON DIOXIDE CONC.	PERCENT	6.47	7.00	8.66	8.66	7.52	7.88	6.82	
OXYGEN CONC.	PERCENT	6.25	1.75	0.25	0.25	0.50	1.70	3.75	
WET CORRECTION FACTOR	--	0.92200	0.89735	0.83992	0.83992	0.86551	0.89305	0.90205	
PROP. TORQUE	FT-LB	8.00	31.00	171.00	171.00	95.00	31.00	5.00	
PROP. SPEED	RPM	600.00	1200.00	2450.00	2450.00	1950.00	1200.00	600.00	
FIELD PRESSURE	IN HG ABS DRY	14.00	12.70	29.40	29.40	19.10	12.30	14.00	
INDUCTION AIR TEMP	DEG F	76.00	75.00	80.00	80.00	79.00	76.00	76.00	
COOLING AIR TEMP	DEG F	86.00	80.00	85.00	85.00	83.00	82.00	80.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	7.90	7.80	13.80	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	235.00	400.00	492.00	492.00	300.00	368.00	405.00	
EXHAUST GAS TEMP	DEG F	750.00	975.00	1285.00	1285.00	1075.00	970.00	750.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10303	0.10047	0.07592	0.07592	0.09401	0.10046	0.10823	0.09466 TA
IND. F/A EQUIV. RATIO	--	1.54	1.50	1.14	1.14	1.41	1.50	1.62	1.42 TA
ENGINE OBSERVED POWER	HP	0.91	7.08	79.77	79.77	35.27	7.08	0.57	
OBS BMEP	PSI	6.00	23.26	128.29	128.29	71.27	23.26	3.75	
OBS BSFC	LBM/BHP-HR	4.158	1.327	0.516	0.516	0.709	1.313	6.653	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.81866	0.42239	0.35339	0.35339	0.54671	0.43393	0.72676	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.89575	0.05963	0.00443	0.00443	0.01550	0.06126	1.27231	
HC MASS / MODE	LB	0.01364	0.07744	0.00177	0.02945	0.05467	0.02170	0.01211	0.21078
HC MASS / RATED HP	LB/HP								0.00211
HC - PERCENT OF EPA STANDARD									110.94
CO EMISSION RATE	LB/HR	3.51921	10.61039	39.30800	39.30800	27.83891	10.01759	3.61267	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.85060	1.49800	0.49277	0.49277	0.78926	1.41431	6.32457	
CO MASS / MODE	LB	0.05865	1.94524	0.19654	3.27567	2.78389	0.50088	0.06021	8.82108
CO MASS / RATED HP	LB/HP								0.08821
CO - PERCENT OF EPA STANDARD									210.03
NOX EMISSION RATE	LB/HR	0.00097	0.00560	0.53903	0.53903	0.05180	0.00439	0.00098	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00106	0.00079	0.00676	0.00676	0.00147	0.00062	0.00171	
NOX MASS / MODE	LB	0.00002	0.00103	0.00270	0.04492	0.00518	0.00022	0.00002	0.05407
NOX MASS / RATED HP	LB/HP								0.00054
NOX- PERCENT OF EPA STANDARD									36.05
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09006	0.09144	0.08689	0.08689	0.09330	0.09031	0.09820	0.09104 TA
DIFF. CALC & MEAS F/A	PERCENT	-12.59	-8.99	14.45	14.45	-0.76	-10.10	-9.26	-3.83 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	1.66	1.66	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.12360	0.98975	1.04433	1.04433	0.98692	1.04037	1.06387	

C-1

C-200-A S/N 251950 TEST 2 BASELINE - 28 DEG BTC RUNS 8-14 11/08/74

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.204	60.00	57.00	2.1250	59.00	100.00	201.00	3.000 5.550	0.908

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.00	9.10	40.50	40.50	25.00	9.50	4.00	
INDUCTION AIR FLOW (W)	LB/HR	37.45	95.00	540.00	540.00	271.00	94.00	35.65	
HYDROCARBON CONC.	PPM-C W	40000.00	9000.00	1250.00	1250.00	3100.00	8600.00	40000.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	25.00	450.00	450.00	125.00	20.00	10.00	
CARBON MONOXIDE CONC.	PERCENT	9.80	10.80	7.40	7.40	9.90	10.70	10.10	
CARBON DIOXIDE CONC.	PERCENT	6.82	7.52	9.27	9.27	8.05	7.52	6.82	
OXYGEN CONC.	PERCENT	5.37	1.60	0.38	0.38	0.63	1.50	4.75	
WET CORRECTION FACTOR	--	0.93550	0.88224	0.84983	0.84983	0.87413	0.90013	0.93999	
PROP. TORQUE	FT-LB	8.00	35.00	178.00	178.00	99.00	33.00	7.00	
PROP. SPEED	RPM	600.00	1200.00	2450.00	2450.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.50	12.80	29.40	29.40	19.20	12.50	13.50	
INDUCTION AIR TEMP	DEG F	57.00	56.00	63.00	63.00	61.00	57.00	57.00	
COOLING AIR TEMP	DEG F	61.00	60.00	70.00	70.00	66.00	61.00	60.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	6.80	6.80	12.20	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	304.00	410.00	492.00	492.00	288.00	370.00	376.00	
EXHAUST GAS TEMP	DEG F	675.00	945.00	1350.00	1350.00	1090.00	950.00	680.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10779	0.09667	0.07569	0.07569	0.09310	0.10199	0.11323	0.09341 TA
IND. F/A EQUIV. RATIO	--	1.61	1.45	1.13	1.13	1.39	1.53	1.69	1.40 TA
ENGINE OBSERVED POWER	HP	0.91	8.00	83.04	83.04	36.76	7.54	0.80	
OBS BMEP	PSI	6.00	26.26	133.54	133.54	74.27	24.76	5.25	
OBS BSFC	LBM/BHP-HR	4.377	1.138	0.488	0.488	0.680	1.260	5.002	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.80227	0.47047	0.34718	0.34718	0.47487	0.46394	0.78790	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.87782	0.05883	0.00418	0.00418	0.01292	0.06153	0.98525	
HC MASS / MODE	LB	0.01337	0.08625	0.[illegible]74	0.02893	0.04749	0.02320	0.01313	0.21411
HC MASS / RATED HP	LB/HP								0.00214
HC - PERCENT OF EPA STANDARD									112.69
CO EMISSION RATE	LB/HR	3.71209	10.05516	35.26160	35.26160	26.76143	10.48925	3.77523	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.06165	1.25737	0.42466	0.42466	0.72806	1.39115	4.72084	
CO MASS / MODE	LB	0.06187	1.84344	0.17631	2.93847	2.67614	0.52446	0.06292	8.28361
CO MASS / RATED HP	LB/HP								0.08284
CO - PERCENT OF EPA STANDARD									197.23
NOX EMISSION RATE	LB/HR	0.00067	0.00433	0.41445	0.41445	0.06349	0.00358	0.00065	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00073	0.00054	0.00499	0.00499	0.00173	0.00047	0.00082	
NOX MASS / MODE	LB	0.00001	0.00079	0.00207	0.03454	0.00635	0.00018	0.00001	0.04395
NOX MASS / RATED HP	LB/HP								0.00044
NOX- PERCENT OF EPA STANDARD									29.30

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09171	0.09252	0.08383	0.08383	0.09070	0.09246	0.09461	0.09047 TA
DIFF. CALC & MEAS F/A	PERCENT	-14.91	-4.29	10.76	10.76	-2.57	-9.34	-16.44	-3.14 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	1.32	1.32	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.10322	1.04613	1.03908	1.03908	1.00651	1.02163	1.08309	

C-2

C-200-A S/N 251950 TEST 3 PART LEAN - 28 DEG BTC RUNS 15-21 11/09/74

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.184	65.50	55.50	2.1250	66.57	100.00	201.00	3.000	5.550	0.701

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.50	5.90	37.50	37.50	20.00	6.00	3.50	
INDUCTION AIR FLOW (W)	LB/HR	32.71	85.00	542.00	542.00	261.00	87.00	32.65	
HYDROCARBON CONC.	PPM-C W	26000.00	2500.00	1150.00	1150.00	2050.00	2000.00	26000.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	210.00	1500.00	1500.00	750.00	275.00	10.25	
CARBON MONOXIDE CONC.	PERCENT	9.80	7.30	6.20	6.20	7.80	6.70	10.10	
CARBON DIOXIDE CONC.	PERCENT	8.05	8.75	9.27	9.27	9.10	9.10	7.17	
OXYGEN CONC.	PERCENT	3.37	1.50	0.35	0.35	1.25	1.50	3.75	
WET CORRECTION FACTOR	--	0.92896	0.85319	0.85319	0.85319	0.85319	0.85319	0.93356	
PROP. TORQUE	FT-LB	8.00	35.00	175.00	175.00	98.00	35.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2440.00	2440.00	1950.00	1200.00	610.00	
MFLD PRESSURE	IN HG ABS DRY	12.80	12.10	29.40	29.40	18.90	12.20	12.80	
INDUCTION AIR TEMP	DEG F	62.00	63.00	72.00	72.00	70.00	65.00	65.00	
COOLING AIR TEMP	DEG F	77.00	66.00	76.00	76.00	74.00	69.00	70.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	7.10	7.10	12.90	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	315.00	458.00	501.00	501.00	315.00	440.00	392.00	
EXHAUST GAS TEMP	DEG F	690.00	1025.00	1375.00	1375.00	1155.00	1020.00	700.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10776	0.06990	0.06968	0.06968	0.07717	0.06945	0.10795	0.07419 TA
IND. F/A EQUIV. RATIO	--	1.61	1.05	1.04	1.04	1.15	1.04	1.62	1.11 TA
ENGINE OBSERVED POWER	HP	0.91	8.00	81.30	81.30	36.39	8.00	0.93	
OBS BMEP	PSI	6.00	26.26	131.29	131.29	73.52	26.26	6.00	
OBS BSFC	LBM/BHP-HR	3.830	0.738	0.461	0.461	0.550	0.750	3.767	

C-3

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.46511	0.10371	0.31746	0.31746	0.27487	0.08600	0.47640	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.50891	0.01297	0.00390	0.00390	0.00755	0.01075	0.51272	
HC MASS / MODE	LB	0.00775	0.01901	0.00159	0.02646	0.02749	0.00430	0.00794	0.09453
HC MASS / RATED HP	LB/HP								0.00095
HC - PERCENT OF EPA STANDARD									49.76
CO EMISSION RATE	LB/HR	3.28772	5.21600	29.47958	29.47958	18.01366	4.96213	3.48781	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.59731	0.65225	0.36259	0.36259	0.49507	0.62050	3.75369	
CO MASS / MODE	LB	0.05480	0.95627	0.14740	2.45663	1.80136	0.24811	0.05813	5.72269
CO MASS / RATED HP	LB/HP								0.05723
CO - PERCENT OF EPA STANDARD									136.25
NOX EMISSION RATE	LB/HR	0.00059	0.02889	1.37307	1.37307	0.33346	0.03921	0.00062	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00065	0.00361	0.01689	0.01689	0.00916	0.00490	0.00067	
NOX MASS / MODE	LB	0.00001	0.00530	0.00687	0.11442	0.03335	0.00196	0.00001	0.16191
NOX MASS / RATED HP	LB/HP								0.00162
NOX- PERCENT OF EPA STANDARD									107.94

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09061	0.08058	0.08150	0.08150	0.08185	0.07868	0.09129	0.08159 TA
DIFF. CALC & MEAS F/A	PERCENT	-15.91	15.28	16.97	16.97	6.06	13.29	-15.43	9.98 TA
DIFF EV & CB RATE	PERCENT	0.05	1.94	2.09	2.09	0.48	1.62	0.05	
SUM OF MOLE FRACTIONS		1.08267	1.07768	1.02513	1.02513	1.05152	1.06329	1.05922	

C-200-A S/N 251950 TEST 4 BASELINE - 28 DEG BTC RUNS 22-28 11/12/74

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.149	65.00	50.50	2.1250	65.00	100.00	201.00	3.000 5.550	0.446

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	28.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.00	9.40	40.30	40.30	25.00	9.40	4.00	
INDUCTION AIR FLOW (W)	LB/HR	37.45	95.00	545.00	545.00	270.00	94.00	35.65	
HYDROCARBON CONC.	PPM-C W	40000.00	8500.00	1350.00	1350.00	3150.00	9500.00	38000.00	
OXIDES OF NITROGEN CONC	PPM W	5.00	25.00	435.00	435.00	125.00	23.00	10.00	
CARBON MONOXIDE CONC.	PERCENT	9.80	10.40	7.80	7.80	10.00	10.60	10.20	
CARBON DIOXIDE CONC.	PERCENT	7.00	7.35	8.92	8.92	8.05	7.35	6.82	
OXYGEN CONC.	PERCENT	4.50	1.38	0.25	0.25	0.44	1.38	4.00	
WET CORRECTION FACTOR	--	0.92421	0.89838	0.85733	0.85733	0.87550	0.89811	0.93353	
PROP. TORQUE	FT-LB	8.50	36.00	176.50	176.50	98.00	36.00	8.50	
PROP. SPEED	RPM	600.00	1700.00	2450.00	2450.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.50	13.00	29.40	29.40	19.30	13.00	13.50	
INDUCTION AIR TEMP	DEG F	62.00	61.00	69.00	69.00	66.00	61.00	62.00	
COOLING AIR TEMP	DEG F	74.00	66.00	74.00	74.00	71.00	66.00	74.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	7.20	7.20	13.20	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	273.00	412.00	494.00	494.00	288.00	412.00	273.00	
EXHAUST GAS TEMP	DEG F	640.00	1090.00	1335.00	1335.00	1090.00	1090.00	640.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10729	0.09939	0.07428	0.07428	0.09301	0.10045	0.11270	0.09400 TA
IND. F/A EQUIV. RATIO	--	1.61	1.49	1.11	1.11	1.39	1.50	1.69	1.41 TA
ENGINE OBSERVED POWER	HP	0.97	11.65	82.34	82.34	36.39	8.23	0.97	
OBS BMEP	PSI	6.38	27.01	132.42	132.42	73.52	27.01	6.38	
OBS BSFC	LBM/BHP-HR	4.119	0.807	0.489	0.489	0.687	1.143	4.119	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.80334	0.46638	0.36852	0.36852	0.47902	0.51286	0.75672	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.82728	0.04002	0.00448	0.00448	0.01316	0.06235	0.77927	
HC MASS / MODE	LB	0.01339	0.08550	0.00184	0.03071	0.04790	0.02564	0.01261	0.21760
HC MASS / RATED HP	LB/HP								0.00218
HC - PERCENT OF EPA STANDARD									114.53
CO EMISSION RATE	LB/HR	3.67217	10.34914	36.85181	36.85181	26.87732	10.37522	3.82793	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.78161	0.88813	0.44758	0.44758	0.73867	1.26136	3.94202	
CO MASS / MODE	LB	0.06120	1.89734	0.18426	3.07098	2.68773	0.51876	0.06380	8.48408
CO MASS / RATED HP	LB/HP								0.08484
CO - PERCENT OF EPA STANDARD									202.00
NOX EMISSION RATE	LB/HR	0.00033	0.00455	0.39376	0.39376	0.06303	0.00412	0.00066	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00034	0.00039	0.00478	0.00478	0.00173	0.00050	0.00068	
NOX MASS / MODE	LB	0.00001	0.00083	0.00197	0.03281	0.00630	0.00021	0.00001	0.04214
NOX MASS / RATED HP	LB/HP								0.00042
NOX- PERCENT OF EPA STANDARD									28.09
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09508	0.09283	0.08571	0.08571	0.09173	0.09375	0.09711	0.09155 TA
DIFF. CALC & MEAS F/A	PERCENT	-11.38	-6.60	15.40	15.40	-1.37	-6.67	-13.83	-2.61 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	2.16	2.16	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.08972	1.00362	1.05789	1.05789	1.00646	1.01142	1.06377	

C-4

C-200-A S/N 251950 TEST 5 BEST POWER - 28 DEG BTC RUNS 29-35 11/12/74

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.049	65.00	50.50	2.1250	65.00	100.00	201.00	3.000 5.550	0.446

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	30.	31.	32.	33.	34.	35.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.50	6.80	38.00	38.00	20.20	6.80	3.50	
INDUCTION AIR FLOW (W)	LB/HR	32.71	85.00	546.00	546.00	262.00	87.00	32.65	
HYDROCARBON CONC.	PPM-C W	26000.00	3350.00	1100.00	1100.00	1900.00	3100.00	10000.00	
OXIDES OF NITROGEN CONC	PPM W	5.00	90.00	1450.00	1450.00	850.00	125.00	15.00	
CARBON MONOXIDE CONC.	PERCENT	9.70	9.10	6.40	6.40	7.60	8.40	9.50	
CARBON DIOXIDE CONC.	PERCENT	7.35	8.40	9.27	9.27	8.92	8.57	7.88	
OXYGEN CONC.	PERCENT	3.75	1.56	0.25	0.25	0.50	1.38	2.13	
WET CORRECTION FACTOR	--	0.93902	0.85733	0.85733	0.85733	0.85733	0.85733	0.94209	
PROP. TORQUE	FT-LB	8.50	35.00	178.00	178.00	99.00	35.00	8.50	
PROP. SPEED	RPM	600.00	1200.00	2450.00	2450.00	1950.00	1200.00	600.00	
FELD PRESSURE IN HG ABS DRY		12.50	12.40	29.40	29.40	18.80	12.40	12.50	
INDUCTION AIR TEMP	DEG F	61.00	61.00	69.00	69.00	66.00	61.00	61.00	
COOLING AIR TEMP	DEG F	78.00	65.00	74.00	74.00	71.00	65.00	78.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	7.50	7.50	13.20	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	330.00	459.00	500.00	500.00	305.00	459.00	330.00	
EXHAUST GAS TEMP	DEG F	670.00	1000.00	1375.00	1375.00	1160.00	1000.00	670.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10748	0.08036	0.06991	0.06991	0.07744	0.07851	0.10768	0.07948 TA
IND. F/A EQUIV. RATIO	--	1.61	1.20	1.05	1.05	1.16	1.17	1.61	1.19 TA
ENGINE OBSERVED POWER	HP	0.97	8.00	83.04	83.04	36.76	8.00	0.97	
OBS BMEP	PSI	6.38	26.26	133.54	133.54	74.27	26.26	6.38	
OBS BSFC	LBM/BHP-HR	3.604	0.850	0.458	0.458	0.550	0.850	3.604	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.47940	0.14561	0.30248	0.30248	0.26200	0.13905	0.19756	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.49368	0.01821	0.00364	0.00364	0.00713	0.01739	0.20345	
HC MASS / MODE	LB	0.00799	0.02669	0.00151	0.02521	0.02621	0.00695	0.00329	0.09786
HC MASS / RATED HP	LB/HP								0.00098
HC - PERCENT OF EPA STANDARD									51.50
CO EMISSION RATE	LB/HR	3.39045	6.84569	30.45865	30.45865	18.14400	6.52108	3.56951	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.49150	0.85604	0.36682	0.36682	0.49361	0.81545	3.67590	
CO MASS / MODE	LB	0.05651	1.25504	0.15229	2.53822	1.81440	0.32605	0.05949	6.20201
CO MASS / RATED HP	LB/HP								0.06202
CO - PERCENT OF EPA STANDARD									147.67
NOX EMISSION RATE	LB/HR	0.00031	0.01297	1.32213	1.32213	0.38879	0.01859	0.00098	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00031	0.00162	0.01592	0.01592	0.01058	0.00232	0.00101	
NOX MASS / MODE	LB	0.00001	0.00238	0.00661	0.11018	0.03888	0.00093	0.00002	0.15900
NOX MASS / RATED HP	LB/HP								0.00159
NOX- PERCENT OF EPA STANDARD									106.00
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09017	0.08485	0.08229	0.08229	0.08460	0.08382	0.08742	0.08447 TA
DIFF. CALC & MEAS F/A	PERCENT	-16.11	5.59	17.71	17.71	9.24	6.77	-18.82	6.28 TA
DIFF EV & CB RATE	PERCENT	0.05	0.37	2.34	2.34	0.95	0.54	0.05	
SUM OF MOLE FRACTIONS		1.05224	1.06604	1.03558	1.03558	1.02004	1.05099	0.99075	

C-5

C-200-A S/N 251950 TEST 6 PART LEAN - 28 DEG BTC RUNS 36-42 11/12/74

PBARO	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.049	65.00	50.50	2.1250	65.00	100.00	201.00	3.000	5.550	0.446

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	36.	37.	38.	39.	40.	41.	42.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.50	5.20	36.80	36.80	19.10	5.20	3.50	
INDUCTION AIR FLOW (W)	LB/HR	32.71	90.00	545.00	545.00	265.00	91.00	32.65	
HYDROCARBON CONC.	PPM-C W	26000.00	400.00	1000.00	1000.00	1700.00	1000.00	10000.00	
OXIDES OF NITROGEN CONC	PPM W	5.00	635.00	2100.00	2100.00	1250.00	550.00	15.00	
CARBON MONOXIDE CONC.	PERCENT	9.70	0.50	4.80	4.80	6.20	2.50	9.50	
CARBON DIOXIDE CONC.	PERCENT	7.35	9.10	9.45	9.45	9.27	9.45	7.88	
OXYGEN CONC.	PERCENT	3.75	3.50	0.25	0.25	0.50	1.88	2.13	
WET CORRECTION FACTOR	--	0.93902	0.91893	0.85733	0.85733	0.85738	0.85733	0.94209	
PROP. TORQUE	FT-LB	8.50	35.00	176.00	176.00	98.00	35.00	8.50	
PROP. SPEED	RPM	600.00	1200.00	2450.00	2450.00	1950.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS DRY		12.50	13.50	29.40	29.40	19.00	13.50	12.50	
INDUCTION AIR TEMP	DEG F	61.00	61.00	70.00	70.00	66.00	61.00	61.00	
COOLING AIR TEMP	DEG F	78.00	65.00	74.00	74.00	70.00	65.00	78.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	7.50	7.50	13.20	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	330.00	458.00	503.00	503.00	308.00	458.00	330.00	
EXHAUST GAS TEMP	DEG F	670.00	1155.00	1405.00	1405.00	1185.00	1155.00	670.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10742	0.05604	0.06783	0.06783	0.07240	0.05740	0.10768	0.06665 TA
IND. F/A EQUIV. RATIO	—	1.61	0.87	1.01	1.01	1.08	0.86	1.61	1.00 TA
ENGINE OBSERVED POWER	HP	0.97	8.00	82.10	82.10	36.39	8.00	0.97	
OBS BMEP	PSI	6.38	26.26	132.04	132.04	73.52	26.26	6.38	
OBS BSFC	LBM/BHP-HR	3.604	0.650	0.448	0.448	0.525	0.650	3.604	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.47940	0.02301	0.29292	0.29292	0.23691	0.04928	0.19756	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.49368	0.00288	0.00357	0.00357	0.00651	0.00616	0.20345	
HC MASS / MODE	LB	0.00799	0.00422	0.00146	0.02441	0.02369	0.00246	0.00329	0.06753
HC MASS / RATED HP	LB/HP								0.00068
HC - PERCENT OF EPA STANDARD									35.54
CO EMISSION RATE	LB/HR	3.39045	0.53362	24.33485	24.33485	14.95410	2.13232	3.56951	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.49150	0.06673	0.29640	0.29640	0.41098	0.26665	3.67590	
CO MASS / MODE	LB	0.05651	0.09783	0.12167	2.02790	1.49541	0.10662	0.05949	3.96543
CO MASS / RATED HP	LB/HP								0.03965
CO - PERCENT OF EPA STANDARD									94.42
NOX EMISSION RATE	LB/HR	0.00031	0.12114	2.03977	2.03977	0.57763	0.08988	0.00098	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00031	0.01515	0.02484	0.02484	0.01588	0.01124	0.00101	
NOX MASS / MODE	LB	0.00001	0.02221	0.01020	0.16998	0.05776	0.00449	0.00002	0.26467
NOX MASS / RATED HP	LB/HP								0.00265
NOX- PERCENT OF EPA STANDARD									176.44
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09017	0.05531	0.07869	0.07869	0.08121	0.06693	0.08742	0.06927 TA
DIFF. CALC & MEAS F/A	PERCENT	-16.11	-4.71	16.01	16.01	12.17	16.60	-18.82	3.92 TA
DIFF EV & EB RATE	PERCENT	0.05	0.05	1.58	1.58	1.30	1.03	0.05	
SUM OF MOLE FRACTIONS		1.05224	0.80948	0.96311	0.96311	1.00241	0.93027	0.99075	

C-6

C-200-A S/N 251950 TEST 7 BASELINE - 26 DEG BTC RUNS 43-49 11/14/74

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.599	70.00	63.00	2.1250	70.00	100.00	201.00	3.000	5.550	1.055

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	43.	44.	45.	73.	47.	48.	49.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.00	9.40	40.50	40.50	25.00	9.25	4.00	
INDUCTION AIR FLOW (W)	LB/HR	37.25	95.00	548.00	548.00	274.00	95.00	35.43	
HYDROCARBON CONC.	PPM-C W	35000.00	8500.00	1500.00	1500.00	3500.00	8500.00	42500.00	
OXIDES OF NITROGEN CONC	PPM W	15.00	27.50	735.00	735.00	125.00	25.00	15.00	
CARBON MONOXIDE CONC.	PERCENT	10.30	10.80	7.80	7.80	10.30	10.60	9.80	
CARBON DIOXIDE CONC.	PERCENT	7.17	7.52	9.19	9.19	8.14	7.44	7.00	
OXYGEN CONC.	PERCENT	3.75	1.25	0.25	0.25	0.38	1.38	4.50	
WET CORRECTION FACTOR	--	0.91164	0.88708	0.84744	0.84744	0.86057	0.88573	0.93401	
PROP. TORQUE	FT-LB	8.00	35.50	177.00	177.00	99.00	34.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2430.00	243^.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.50	12.90	29.40	29.40	19.30	12.40	13.60	
INDUCTION AIR TEMP	DEG F	64.00	65.00	73.00	0.0	72.00	69.00	67.00	
COOLING AIR TEMP	DEG F	84.00	68.00	80.00	80.00	79.00	74.00	95.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	6.80	6.80	12.20	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	295.00	410.00	490.00	490.00	299.00	358.00	360.00	
EXHAUST GAS TEMP	DEG F	765.00	590.00	1345.00	1345.00	1105.00	970.00	675.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10853	0.10000	0.07469	0.07469	0.09221	0.09841	0.11410	0.09403 TA
IND. F/A EQUIV. RATIO	--	1.62	1.50	1.12	1.12	1.38	1.47	1.71	1.41 TA
ENGINE OBSERVED POWER	HP	0.91	8.11	81.89	81.89	36.76	7.77	0.91	
CBS BMEP	PSI	6.00	26.63	132.79	132.79	74.27	25.51	6.00	
CBS BSFC	LBM/BHP-HR	4.377	1.159	0.495	0.495	0.680	1.191	4.377	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.70639	0.45795	0.40945	0.40945	0.52901	0.45811	0.83580	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.77291	0.05646	0.00500	0.00500	0.01439	0.05897	0.91450	
HC MASS / MODE	LB	0.01177	0.08396	0.00205	0.03412	0.05290	0.02291	0.01393	0.22163
HC MASS / RATED HP	LB/HP								0.00222
HC - PERCENT OF EPA STANDARD									116.65
CO EMISSION RATE	LB/HR	3.82580	10.42000	36.42511	36.42511	27.04620	10.21510	3.63394	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.18607	1.28469	0.44478	0.44478	0.73580	1.31494	3.97614	
CO MASS / MODE	LB	0.06376	1.91033	0.18213	3.03543	2.70462	0.51075	0.06057	8.46759
CO MASS / RATED HP	LB/HP								0.08468
CO - PERCENT OF EPA STANDARD									201.61
NOX EMISSION RATE	LB/HR	0.00100	0.00491	0.66528	0.66528	0.06265	0.00447	0.00098	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00110	0.00061	0.00812	0.00812	0.00170	0.00058	0.00107	
NOX MASS / MODE	LB	0.00002	0.00090	0.00333	0.05544	0.00626	0.00022	0.00002	0.06619
NOX MASS / RATED HP	LB/HP								0.00066
NOX- PERCENT OF EPA STANDARD									44.13
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09641	0.09375	0.08539	0.08539	0.09260	0.09305	0.09608	0.09198 TA
DIFF. CALC & MEAS F/A	PERCENT	-11.17	-6.25	14.32	14.32	0.41	-5.44	-15.80	-2.18 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	1.99	1.99	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.08545	1.02507	1.06828	1.06828	1.02582	1.02017	1.07503	

C-200-A S/N 251950 TEST 8 BASELINE - 30 DEG BTC RUNS 50-56 11/14/74

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.096	75.00	62.00	2.1250	75.00	100.00	201.00	3.000	5.550	0.879

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	50.	51.	52.	53.	54.	55.	56.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.00	9.30	40.00	40.00	25.00	8.90	4.00	
INDUCTION AIR FLOW (W)	LB/HR	35.45	93.00	545.00	545.00	273.00	90.00	35.42	
HYDROCARBON CONC.	PPM-C W	42000.00	8250.00	1500.00	1500.00	3000.00	9000.00	47000.00	
OXIDES OF NITROGEN CONC	PPM W	8.00	30.00	725.00	725.00	125.00	25.50	10.50	
CARBON MONOXIDE CONC.	PERCENT	9.80	10.80	8.00	8.00	10.20	10.60	9.80	
CARBON DIOXIDE CONC.	PERCENT	7.00	7.44	9.10	9.10	8.40	7.70	6.65	
OXYGEN CONC.	PERCENT	4.75	1.25	0.25	0.25	0.38	1.38	5.25	
WET CORRECTION FACTOR	--	0.94052	0.85269	0.85031	0.85031	0.86472	0.89117	0.94133	
PROP. TORQUE	FT-LB	8.00	36.00	176.00	176.00	98.50	34.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2425.00	2425.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.50	12.70	29.40	29.40	19.10	12.20	13.50	
INDUCTION AIR TEMP	DEG F	69.00	65.00	77.00	77.00	75.00	71.00	70.00	
COOLING AIR TEMP	DEG F	90.00	76.00	81.00	81.00	80.00	77.00	104.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	8.40	8.40	13.60	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	292.00	395.00	491.00	491.00	302.00	358.00	346.00	
EXHAUST GAS TEMP	DEG F	615.00	520.00	1310.00	1310.00	1085.00	940.00	620.00	
INDUCTION F/A RATIO (D)	LB/LB	0.11371	0.10089	0.07405	0.07405	0.09239	0.09977	0.11393	0.09463 TA
IND. F/A EQUIV. RATIO	--	1.70	1.51	1.11	1.11	1.38	1.49	1.70	1.42 TA
ENGINE OBSERVED POWER	HP	0.91	8.23	81.26	81.26	36.57	7.77	0.91	
OBS BMEP	PSI	6.00	27.01	132.04	132.04	73.90	25.51	6.00	
OBS BSFC	LBM/BHP-HR	4.377	1.131	0.492	0.492	0.684	1.146	4.377	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.82324	0.43574	0.40043	0.40043	0.44880	0.45635	0.91315	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.90076	0.05346	0.00493	0.00493	0.01227	0.05874	0.99914	
HC MASS / MODE	LB	0.01372	0.08062	0.00200	0.03337	0.04488	0.02282	0.01522	0.21263
HC MASS / RATED HP	LB/HP								0.00213
HC - PERCENT OF EPA STANDARD									111.91
CO EMISSION RATE	LB/HR	3.64873	10.37426	36.65996	36.65996	26.63766	9.66966	3.61824	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.99232	1.26124	0.45112	0.45112	0.72837	1.24473	3.95896	
CO MASS / MODE	LB	0.06081	1.90195	0.18330	3.05500	2.66377	0.48348	0.06030	8.40861
CO MASS / RATED HP	LB/HP								0.08409
CO - PERCENT OF EPA STANDARD									200.20
NOX EMISSION RATE	LB/HR	0.00052	0.00530	0.64178	0.64178	0.06201	0.00429	0.00068	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00057	0.00064	0.00790	0.00790	0.00170	0.00055	0.00074	
NOX MASS / MODE	LB	0.00001	0.00097	0.00321	0.05348	0.00620	0.00021	0.00001	0.06410
NOX MASS / RATED HP	LB/HP								0.00064
NOX- PERCENT OF EPA STANDARD									42.73

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09465	0.09380	0.08590	0.08590	0.09154	0.09268	0.09576	0.09175 TA
DIFF. CALC & MEAS F/A	PERCENT	-16.76	-7.02	16.01	16.01	-0.92	-7.10	-15.95	-3.05 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	2.34	2.34	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.08206	1.01725	1.08284	1.08284	1.03344	1.03080	1.08724	

C-200-A S/N 251950 TEST 9 BASELINE - 34 DEG BTC RUNS 57-63 11/14/74

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.089	63.00	61.00	2.1250	58.70	100.00	201.00	3.000 5.550	1.082

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	57.	58.	59.	60.	61.	62.	63.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.00	9.80	40.50	40.50	24.50	9.50	4.00	
INDUCTION AIR FLOW (W)	LB/HR	37.45	95.00	552.00	552.00	268.00	95.00	37.45	
HYDROCARBON CONC.	PPM-C W	41000.00	9250.00	1350.00	1350.00	2850.00	9500.00	49000.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	25.00	1025.00	1025.00	135.00	20.00	10.00	
CARBON MONOXIDE CONC.	PERCENT	9.75	10.45	7.20	7.20	9.90	10.45	9.55	
CARBON DIOXIDE CONC.	PERCENT	7.00	7.70	9.45	9.45	8.05	7.52	6.91	
OXYGEN CONC.	PERCENT	5.70	1.50	0.38	0.38	0.50	1.37	5.37	
WET CORRECTION FACTOR	--	0.93841	0.90618	0.84700	0.84700	0.86829	0.89348	0.91793	
PROP. TORQUE	FT-LB	8.00	37.00	179.50	179.50	99.00	34.00	7.00	
PROP. SPEED	RPM	600.00	1200.00	2430.00	2430.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.50	12.50	29.40	29.40	18.80	12.40	13.50	
INDUCTION AIR TEMP	DEG F	58.00	58.00	63.00	63.00	61.00	57.00	56.00	
COOLING AIR TEMP	DEG F	66.00	61.00	65.00	65.00	62.00	58.00	60.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	8.20	8.20	13.80	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	310.00	392.00	490.00	490.00	288.00	356.00	350.00	
EXHAUST GAS TEMP	DEG F	610.00	970.00	1325.00	1325.00	1070.00	920.00	535.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10798	0.10429	0.07417	0.07417	0.09242	0.10109	0.10798	0.09575 TA
IND. F/A EQUIV. RATIO	--	1.62	1.56	1.11	1.11	1.38	1.51	1.62	1.43 TA
ENGINE OBSERVED POWER	HP	0.91	8.45	83.05	83.05	36.76	7.77	0.80	
OBS BMEP	PSI	6.00	27.76	134.67	134.67	74.27	25.51	5.25	
OBS BSFC	LBM/BHP-HR	4.377	1.159	0.488	0.488	0.667	1.223	5.002	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.81131	0.51159	0.37650	0.37650	0.43134	0.52017	0.96028	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.88771	0.06052	0.00453	0.00453	0.01173	0.06696	1.20080	
HC MASS / MODE	LB	0.01352	0.09379	0.00188	0.03137	0.04313	0.02601	0.01600	0.22572
HC MASS / RATED HP	LB/HP								0.00226
HC - PERCENT OF EPA STANDARD									118.80
CO EMISSION RATE	LB/HR	3.65497	10.57300	34.33452	34.33452	26.26407	10.32067	3.46817	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.99915	1.25066	0.41341	0.41341	0.71452	1.32853	4.33686	
CO MASS / MODE	LB	0.06092	1.93838	0.17167	2.86121	2.62641	0.51603	0.05780	8.23242
CO MASS / RATED HP	LB/HP								0.08232
CO - PERCENT OF EPA STANDARD									196.01
NOX EMISSION RATE	LB/HR	0.00066	0.00458	0.94790	0.94790	0.06775	0.00363	0.00065	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00072	0.00054	0.01141	0.01141	0.00184	0.00047	0.00081	
NOX MASS / MODE	LB	0.00001	0.00084	0.00474	0.07899	0.00678	0.00018	0.00001	0.09155
NOX MASS / RATED HP	LB/HP								0.00092
NOX- PERCENT OF EPA STANDARD									61.03

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09041	0.09192	0.08326	0.08326	0.09112	0.09310	0.09578	0.09028 TA
DIFF. CALC & MEAS F/A	PERCENT	-16.26	-11.85	12.26	12.26	-1.40	-7.91	-11.29	-5.71 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	1.59	1.59	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.12134	1.01461	1.05274	1.05274	1.00495	1.01203	1.11543	

C-200-A S/N 251950 TEST 10 BEST POWER - 30 DEG BTC RUNS 64-70 11/19/74

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.049	70.00	69.00	2.1250	71.00	100.00	201.00	3.000	5.550	1.473

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	64.	65.	66.	67.	68.	69.	70.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.69	6.00	37.00	37.00	20.50	5.80	2.56	
INDUCTION AIR FLOW (W)	LB/HR	34.71	90.00	542.00	542.00	265.00	88.00	28.50	
HYDROCARBON CONC.	PPM-C W	16500.00	3250.00	1150.00	1150.00	2650.00	2700.00	11250.00	
OXIDES OF NITROGEN CONC	PPM W	15.00	175.00	1500.00	1500.00	665.00	200.00	12.00	
CARBON MONOXIDE CONC.	PERCENT	7.65	7.60	6.10	6.10	7.90	6.40	9.20	
CARBON DIOXIDE CONC.	PERCENT	6.20	6.70	7.20	7.20	6.90	6.60	5.60	
OXYGEN CONC.	PERCENT	3.72	0.87	0.25	0.25	0.50	1.25	2.63	
WET CORRECTION FACTOR	--	0.96422	0.84059	0.84059	0.84059	0.84113	0.84059	0.88903	
PROP. TORQUE	FT-LB	9.50	36.00	176.00	176.00	100.00	35.50	9.00	
PROP. SPEED	RPM	600.00	1200.00	2440.00	2440.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.90	11.90	29.40	29.40	18.90	11.50	11.40	
INDUCTION AIR TEMP	DEG F	66.00	67.00	75.00	75.00	74.00	69.00	70.00	
COOLING AIR TEMP	DEG F	70.00	69.00	80.00	80.00	79.00	75.00	97.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	6.60	6.60	11.30	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	325.00	440.00	498.00	498.00	325.00	439.00	383.00	
EXHAUST GAS TEMP	DEG F	600.00	1025.00	1365.00	1365.00	1150.00	1055.00	610.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10790	0.06766	0.06929	0.06929	0.07851	0.06689	0.09117	0.07261 TA
IND. F/A EQUIV. RATIO	--	1.61	1.01	1.04	1.04	1.17	1.00	1.36	1.09 TA
ENGINE OBSERVED POWER	HP	1.09	8.23	81.77	81.77	37.13	8.11	1.03	
OBS BMEP	PSI	7.13	27.01	132.04	132.04	75.02	26.63	6.75	
OBS BSFC	LBM/BHP-HR	3.400	0.729	0.453	0.453	0.552	0.715	2.490	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.39783	0.15486	0.36934	0.36934	0.41893	0.13711	0.19769	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.36656	0.01883	0.00452	0.00452	0.01128	0.01690	0.19227	
HC MASS / MODE	LB	0.00663	0.02839	0.00185	0.03078	0.04189	0.00686	0.00329	0.11969
HC MASS / RATED HP	LB/HP								0.00120
HC - PERCENT OF EPA STANDARD									62.99
CO EMISSION RATE	LB/HR	3.59037	6.14523	33.24533	33.24533	21.20636	5.51518	2.90155	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.30818	0.74710	0.40659	0.40659	0.57116	0.67995	2.82203	
CO MASS / MODE	LB	0.05984	1.12662	0.16623	2.77044	2.12064	0.27576	0.04836	6.56789
CO MASS / RATED HP	LB/HP								0.06568
CO - PERCENT OF EPA STANDARD									156.38
NOX EMISSION RATE	LB/HR	0.00120	0.02765	1.59746	1.59746	0.34859	0.03368	0.00070	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00110	0.00336	0.01954	0.01954	0.00939	0.00415	0.00068	
NOX MASS / MODE	LB	0.00002	0.00507	0.00799	0.13312	0.03486	0.00168	0.00001	0.18275
NOX MASS / RATED HP	LB/HP								0.00183
NOX- PERCENT OF EPA STANDARD									121.84
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08311	0.08797	0.08506	0.08506	0.08967	0.08295	0.09059	0.08714 TA
DIFF. CALC & MEAS F/A	PERCENT	-22.97	30.01	22.77	22.77	14.21	24.00	-0.64	20.01 TA
DIFF EV & CB RATE	PERCENT	0.05	2.64	1.05	1.05	0.05	1.12	0.05	
SUM OF MOLE FRACTIONS		0.87232	0.98268	0.88247	0.88247	0.90669	0.90316	0.92324	

C-200-A S/N 251950 TEST 11 BASELINE - 28 DEG BTC RUNS 71-77 11/19/74

C-11

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.133	70.00	52.20	2.1250	67.85	100.00	201.00	3.000 5.550	0.423

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	71.	72.	73.	74.	75.	76.	77.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.80	9.00	40.00	40.00	25.00	9.00	3.80	
INDUCTION AIR FLOW (W)	LB/HR	35.49	91.00	536.00	536.00	269.00	89.00	35.49	
HYDROCARBON CONC.	PPM-C W	37500.00	7250.00	1350.00	1350.00	3500.00	8200.00	32500.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	26.00	775.00	775.00	130.00	25.00	10.00	
CARBON MONOXIDE CONC.	PERCENT	9.80	10.40	7.80	7.80	10.10	10.50	10.00	
CARBON DIOXIDE CONC.	PERCENT	6.40	6.50	8.80	8.80	6.20	5.70	6.10	
OXYGEN CONC.	PERCENT	3.72	1.25	0.38	0.38	0.50	1.38	3.13	
WET CORRECTION FACTOR	--	0.91565	0.89943	0.85770	0.85770	0.87947	0.90592	0.91252	
FROP. TORQUE	FT-LB	8.00	36.00	174.00	174.00	100.00	34.00	8.50	
FROP. SPEED	RPM	600.00	1200.00	2440.00	2440.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.50	12.80	29.40	29.40	19.40	12.10	13.00	
INDUCTION AIR TEMP	DEG F	65.00	65.00	73.00	73.00	71.00	69.00	67.00	
COOLING AIR TEMP	DEG F	70.00	69.00	81.00	81.00	78.00	74.00	74.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	6.20	6.20	11.10	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	325.00	428.00	490.00	490.00	305.00	338.00	365.00	
EXHAUST GAS TEMP	DEG F	650.00	575.00	1315.00	1315.00	1090.00	940.00	620.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10753	0.09932	0.07494	0.07494	0.09333	0.10155	0.10753	0.09412 TA
IND. F/A EQUIV. RATIO	--	1.61	1.49	1.12	1.12	1.40	1.52	1.61	1.41 TA
ENGINE OBSERVED POWER	HP	0.91	8.23	80.84	80.84	37.13	7.77	0.97	
OBS BMEP	PSI	6.00	27.01	130.54	130.54	75.02	25.51	6.38	
OBS BSFC	LBM/BHP-HR	4.158	1.094	0.495	0.495	0.673	1.159	3.913	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.75179	0.40170	0.36835	0.36835	0.58416	0.46693	0.67486	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.82258	0.04884	0.00456	0.00456	0.01573	0.06011	0.69498	
HC MASS / MODE	LB	0.01253	0.07364	0.00184	0.03070	0.05842	0.02335	0.01125	0.21172
HC MASS / RATED HP	LB/HP								0.00212
HC - PERCENT OF EPA STANDARD									111.43
CO EMISSION RATE	LB/HR	3.63167	10.46282	36.85048	36.85048	29.92906	10.93452	3.82525	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.97365	1.27201	0.45586	0.45586	0.80609	1.40755	3.93926	
CO MASS / MODE	LB	0.06053	1.91818	0.18425	3.07087	2.99291	0.54673	0.06375	8.83722
CO MASS / RATED HP	LB/HP								0.08837
CO - PERCENT OF EPA STANDARD									210.41
NOX EMISSION RATE	LB/HR	0.00066	0.00478	0.70119	0.70119	0.07195	0.00472	0.00069	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00073	0.00058	0.00867	0.00867	0.00194	0.00061	0.00071	
NOX MASS / MODE	LB	0.00001	0.00088	0.00351	0.05843	0.00719	0.00024	0.00001	0.07027
NOX MASS / RATED HP	LB/HP								0.00070
NOX- PERCENT OF EPA STANDARD									46.84

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09899	0.09495	0.08539	0.08539	0.09690	0.09759	0.10050	0.09416 TA
DIFF. CALC & MEAS F/A	PERCENT	-7.93	-4.40	13.94	13.94	3.83	-3.90	-6.53	0.05 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	1.81	1.81	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.03065	0.99255	1.04469	1.04469	0.91448	0.91320	0.99657	

C-200-A S/N 251950 (RERUN) TEST 1 BASELINE RUNS 1-7 08/05/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.289	82.50	77.50	2.1250	82.50	100.00	201.00	3.000 5.550	1.887

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.50	8.50	45.00	45.00	25.50	8.50	3.50	
INDUCTION AIR FLOW (W)	LB/HR	42.60	100.10	601.40	601.40	297.80	98.10	41.00	
HYDROCARBON CONC.	PPM-C W	41250.00	8100.00	3150.00	3150.00	5250.00	9300.00	37500.00	
OXIDES OF NITROGEN CONC	PPM W	5.00	10.62	137.50	137.50	40.00	13.00	5.75	
CARBON MONOXIDE CONC.	PERCENT	8.55	11.10	9.05	9.05	11.20	10.95	9.70	
CARBON DIOXIDE CONC.	PERCENT	6.25	7.01	9.25	9.25	7.70	7.01	6.00	
OXYGEN CONC.	PERCENT	4.62	1.37	0.25	0.25	0.50	1.50	3.75	
WET CORRECTION FACTOR	--	0.83373	0.83373	0.83373	0.83373	0.83373	0.83691	0.83373	
FROP. TORQUE	FT-LB	9.00	30.00	167.00	167.00	96.00	33.00	10.00	
FROP. SPEED	RPM	600.00	1200.00	2435.00	2435.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	12.30	11.90	29.30	29.30	19.70	11.60	12.50	
INDUCTION AIR TEMP	DEG F	84.00	83.00	87.00	87.00	86.00	86.00	85.00	
COOLING AIR TEMP	DEG F	94.00	90.00	97.00	97.00	96.00	96.00	96.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.40	3.40	3.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	288.00	365.00	515.00	515.00	395.00	350.00	375.00	
EXHAUST GAS TEMP	DEG F	325.00	380.00	1050.00	1050.00	785.00	475.00	275.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08374	0.08655	0.07626	0.07626	0.08728	0.08831	0.08701	0.08482 TA
IND. F/A EQUIV. RATIO	--	1.25	1.29	1.14	1.14	1.31	1.32	1.30	1.27 TA
ENGINE OBSERVED POWER	HP	1.03	6.85	77.43	77.43	35.64	7.54	1.14	
OBS BMEP	PSI	6.75	22.51	125.29	125.29	72.02	24.76	7.50	
OBS BSFC	LBM/BHP-HR	3.404	1.240	0.581	0.581	0.715	1.127	3.064	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.85973	0.45402	0.69245	0.89245	0.80610	0.48597	0.76415	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.83617	0.06624	0.01153	0.01153	0.02262	0.06440	0.66889	
HC MASS / MODE	LB	0.01433	0.08324	0.00446	0.07437	0.08061	0.02428	0.01274	0.29402
HC MASS / RATED HP	LB/HP								0.00294
HC - PERCENT OF EPA STANDARD									154.75
CO EMISSION RATE	LB/HR	2.99926	5.74964	43.15491	43.15491	28.94394	9.65939	3.32682	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.91706	1.42236	0.55736	0.55736	0.81205	1.28109	2.91208	
CO MASS / MODE	LB	0.04999	1.78743	0.21577	3.59624	2.89439	0.48297	0.05545	9.08224
CO MASS / RATED HP	LB/HP								0.09082
CO - PERCENT OF EPA STANDARD									216.24
NOX EMISSION RATE	LB/HR	0.00035	0.00184	0.12918	0.12918	0.02037	0.00225	0.00039	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00034	0.00027	0.00167	0.00167	0.00057	0.00030	0.00034	
NOX MASS / MODE	LB	0.00001	0.00034	0.00065	0.01076	0.00204	0.00011	0.00001	0.01391
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.27

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09732	0.09550	0.08852	0.08852	0.09579	0.09496	0.10195	0.09445 TA
DIFF. CALC & MEAS F/A	PERCENT	16.21	10.34	16.07	16.07	9.76	7.53	17.17	11.36 TA
DIFF EV & CB RATE	PERCENT	0.75	0.44	2.57	2.57	0.80	0.05	0.89	
SUM OF MOLE FRACTIONS		1.10115	1.06713	1.13746	1.13746	1.08011	1.05200	1.09533	

C-200-A S/N 251950 (RERUN) TEST 2 BASELINE RUNS 8-14 08/05/76

PBARC IN HG ABS	TCRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.067	86.50	77.00	2.1250	86.50	100.00	201.00	3.000 5.550	1.753

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.50	8.90	45.00	45.00	26.00	8.60	3.40	
INDUCTION AIR FLOW (W)	LB/HR	43.30	105.00	603.00	603.00	304.30	101.70	38.38	
HYDROCARBON CONC.	PPM-C W	37500.00	7500.00	3150.00	3150.00	5025.00	7800.00	46500.00	
OXIDES OF NITROGEN CONC	PPM W	2.75	14.50	168.75	168.75	51.00	14.75	2.75	
CARBON MONOXIDE CONC.	PERCENT	8.90	10.90	8.95	8.95	11.15	11.00	9.40	
CARBON DIOXIDE CONC.	PERCENT	6.75	7.40	9.40	9.40	7.95	7.40	5.60	
OXYGEN CONC.	PERCENT	4.00	1.25	0.25	0.25	0.50	1.25	4.62	
WET CORRECTION FACTOR	--	0.83596	0.83596	0.83596	0.83596	0.83596	0.83596	0.83596	
PROP. TORQUE	FT-LB	11.00	35.00	164.00	164.00	98.00	36.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2435.00	2435.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	12.80	11.90	29.30	29.30	19.90	11.80	13.00	
INDUCTION AIR TEMP	DEG F	86.00	85.00	90.00	90.00	90.00	90.00	89.00	
COOLING AIR TEMP	DEG F	93.00	91.00	99.00	99.00	100.00	100.00	100.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.40	3.40	3.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	268.00	355.00	500.00	500.00	395.00	355.00	366.00	
EXHAUST GAS TEMP	DEG F	375.00	405.00	1050.00	1050.00	800.00	500.00	335.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08227	0.08627	0.07596	0.07596	0.08697	0.08607	0.09017	0.08440 TA
IND. F/A EQUIV. RATIO	--	1.23	1.29	1.14	1.14	1.30	1.29	1.35	1.26 TA
ENGINE OBSERVED POWER	HP	1.26	8.00	76.04	76.04	36.39	8.23	1.14	
OBS BMEP	PSI	8.25	26.26	123.04	123.04	73.52	27.01	7.50	
OBS BSFC	LBM/BHP-HR	2.785	1.113	0.592	0.592	0.715	1.046	2.976	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.76445	0.40179	0.88773	0.88773	0.77775	0.40692	0.90173	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.60832	0.05099	0.01168	0.01168	0.02137	0.04947	0.78932	
HC MASS / MODE	LB	0.01274	0.07476	0.00444	0.07398	0.07778	0.02035	0.01503	0.27907
HC MASS / RATED HP	LB/HP								0.00279
HC - PERCENT OF EPA STANDARD									146.88
CO EMISSION RATE	LB/HR	3.06185	10.00172	42.56639	42.56639	29.12410	9.68469	3.07629	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.43649	1.25069	0.55982	0.55982	0.80042	1.17741	2.69278	
CO MASS / MODE	LB	0.05103	1.83365	0.21283	3.54720	2.91241	0.48423	0.05127	9.09262
CO MASS / RATED HP	LB/HP								0.09093
CO - PERCENT OF EPA STANDARD									216.49
NOX EMISSION RATE	LB/HR	0.00019	0.00261	0.15770	0.15770	0.02617	0.00255	0.00018	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00015	0.00033	0.00207	0.00207	0.00072	0.00031	0.00015	
NOX MASS / MODE	LB	0.00000	0.00048	0.00079	0.01314	0.00262	0.00013	0.00000	0.01716
NOX MASS / RATED HP	LB/HP								0.00017
NOX- PERCENT OF EPA STANDARD									11.44
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09717	0.09394	0.08808	0.08808	0.09493	0.09430	0.10379	0.09354 TA
DIFF. CALC & MEAS F/A	PERCENT	18.10	8.89	15.96	15.96	9.15	9.56	15.11	10.83 TA
DIFF EV & CB RATE	PERCENT	1.54	0.44	2.65	2.65	0.90	0.60	0.23	
SUM OF MOLE FRACTIONS		1.13947	1.07371	1.14460	1.14460	1.09354	1.08261	1.08184	

C-200-A S/N 251950 (RERUN) TEST 3 LEAN OLT RUNS 15-21 08/05/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.067	86.50	77.00	2.1250	86.50	100.00	201.00	3.000	5.550	1.753

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	11.00	0.30	0.30
FUEL FLOW	LB/HR	3.50	2.50	8.50	7.30	6.60	45.00	40.00
INDUCTION AIR FLOW (W)	LB/HR	40.60	40.20	101.00	98.80	98.80	599.00	600.50
HYDROCARBON CONC.	PPM-C W	42750.00	33750.00	8250.00	4350.00	2775.00	3150.00	2535.00
OXIDES OF NITROGEN CONC	PPM W	3.13	10.00	16.87	52.00	130.00	175.00	750.00
CARBON MONOXIDE CONC.	PERCENT	8.90	2.65	10.75	8.05	4.25	8.70	5.40
CARBON DIOXIDE CONC.	PERCENT	5.85	8.15	7.35	9.15	11.40	9.30	11.15
OXYGEN CONC.	PERCENT	4.75	6.87	1.37	1.25	1.13	0.25	0.25
WET CORRECTION FACTOR	--	0.83762	0.84435	0.83596	0.83596	0.83596	0.83596	0.83596
PROP. TORQUE	FT-LB	11.00	15.00	36.00	38.00	37.00	167.00	170.00
PROP. SPEED	RPM	600.00	600.00	1200.00	1200.00	1200.00	2435.00	2440.00
MFLD PRESSURE	IN HG ABS DRY	12.50	11.50	11.80	11.70	12.00	29.30	29.30
INDUCTION AIR TEMP	DEG F	90.00	90.00	88.00	88.00	88.00	91.00	92.00
COOLING AIR TEMP	DEG F	100.00	100.00	99.00	99.00	98.00	99.00	100.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	4.80	4.80
MAX CYL HEAD TEMP	DEG F	280.00	311.00	355.00	403.00	433.00	483.00	490.00
EXHAUST GAS TEMP	DEG F	340.00	220.00	425.00	420.00	425.00	1050.00	1100.00
INDUCTION F/A RATIO (D)	LB/LB	0.08774	0.06330	0.08566	0.07520	0.06799	0.07647	0.06780
IND. F/A EQUIV. RATIO	--	1.31	0.95	1.28	1.13	1.02	1.14	1.01
ENGINE OBSERVED POWER	HP	1.26	1.71	8.23	8.68	8.45	77.43	78.98
OBS BMEP	PSI	8.25	11.25	27.01	28.51	27.76	125.29	127.54
OBS BSFC	LBM/BHP-HR	2.785	1.459	1.033	0.841	0.781	0.581	0.506
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.88211	0.66210	0.43088	0.21017	0.13460	0.90464	0.70563
BRAKE SPECIFIC HC	LBM/BHP-HR	0.70195	0.38637	0.05238	0.02421	0.01590	0.01168	0.00893
HC MASS / MODE	LB	0.01470	0.01103	0.07900	0.03853	0.02464	0.00452	0.00353
CO EMISSION RATE	LB/HR	3.10536	0.88614	9.47518	6.56359	3.47375	42.16547	25.36679
BRAKE SPECIFIC CO	LBM/BHP-HR	2.47111	0.51711	1.15194	0.75596	0.41090	0.54459	0.32118
CO MASS / MODE	LB	0.05176	0.01477	1.73712	1.20332	0.63685	0.21083	0.12683
NOX EMISSION RATE	LB/HR	0.00021	0.00065	0.00292	0.00833	0.02088	0.16665	0.69225
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00017	0.00038	0.00036	0.00096	0.00247	0.00215	0.00876
NOX MASS / MODE	LB	0.00000	0.00001	0.00054	0.00153	0.00383	0.00083	0.00346
** DATA VALIDITY CHECKS FOR ENGLOI **								
CAL. FUEL AIR RATIO	LB/LB	0.09920	0.07023	0.09370	0.08358	0.07390	0.08781	0.07914
DIFF. CALC & MEAS F/A	PERCENT	13.06	10.96	9.38	11.14	8.68	14.84	16.73
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.47	1.41	1.16	2.30	2.83
SUM OF MOLE FRACTIONS		1.07295	1.05166	1.07265	1.09714	1.06674	1.11779	1.12036

C-14

C-200-A S/N 251950 (RERUN) TEST 3A LEAN OUT RUNS 22-27 08/05/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.067	86.50	77.00	2.1250	8.50	100.00	201.00	3.000 5.550	1.753

	UNITS	MODE 3	MODE 3	MODE 5	MODE 5	MODE 5	MODE 5	MODE 0
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	
TIME IN MODE	MINUTES	0.30	0.30	6.00	6.00	6.00	6.00	
FUEL FLOW	LB/HR	35.00	32.50	26.00	23.00	20.00	17.80	
INDUCTION AIR FLOW (W)	LB/HR	598.30	598.30	300.40	297.30	296.40	296.80	
HYDROCARBON CONC.	PPM-C W	1650.00	750.00	5250.00	3900.00	2550.00	1575.00	
OXIDES OF NITROGEN CONC	PPM W	1375.00	1375.00	52.00	140.00	750.00	1375.00	
CARBON MONOXIDE CONC.	PERCENT	2.05	0.40	10.95	8.25	3.50	0.90	
CARBON DIOXIDE CONC.	PERCENT	13.00	13.45	7.70	9.40	12.20	13.35	
OXYGEN CONC.	PERCENT	0.38	0.75	0.50	0.50	0.50	0.88	
WET CORRECTION FACTOR	--	0.83596	0.83596	0.83596	0.83596	0.83596	0.83596	
PROP. TORQUE	FT-LB	169.00	166.00	97.00	98.00	99.00	97.00	
PROP. SPEED	RPM	2440.00	2400.00	1950.00	1950.00	1950.00	1950.00	
MFLD PRESSURE	IN HG ABS DRY	29.30	29.40	19.40	19.20	19.30	19.40	
INDUCTION AIR TEMP	DEG F	93.00	93.00	90.00	90.00	90.00	90.00	
COOLING AIR TEMP	DEG F	100.00	101.00	99.00	99.00	100.00	100.00	
COOLING AIR DELTA P	IN H2O	4.80	4.80	4.80	4.80	4.80	4.80	
MAX CYL HEAD TEMP	DEG F	488.00	470.00	380.00	370.00	391.00	391.00	
EXHAUST GAS TEMP	DEG F	1150.00	1175.00	750.00	775.00	825.00	850.00	
INDUCTION F/A RATIO (D)	LB/LB	0.05954	0.05529	0.08810	0.07874	0.06868	0.06104	
IND. F/A EQUIV. RATIO	--	0.89	0.83	1.32	1.18	1.03	0.91	
ENGINE OBSERVED POWER	HP	78.51	75.86	36.01	36.39	36.76	36.01	
OBS BMEP	PSI	126.79	124.54	72.77	73.52	74.27	72.77	
OBS BSFC	LBM/BHP-HR	0.446	0.428	0.722	0.632	0.544	0.494	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 3	MODE 3	MODE 5	MODE 5	MODE 5	MODE 5
HC EMISSION RATE	LB/HR	0.44420	0.20656	0.83041	0.58068	0.37371	0.22772
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00566	0.00272	0.02306	0.01596	0.01017	0.00632
HC MASS / MODE	LB	0.00222	0.00103	0.08304	0.05807	0.03737	0.02277
CO EMISSION RATE	LB/HR	9.31369	1.85914	29.22943	20.73012	8.65639	2.19603
BRAKE SPECIFIC CO	LBM/BHP-HR	0.11862	0.02451	0.81159	0.56973	0.23550	0.06098
CO MASS / MODE	LB	0.04657	0.00930	2.92294	2.07301	0.86564	0.21960
NOX EMISSION RATE	LB/HR	1.22745	1.25570	0.02727	0.06912	0.36447	0.65922
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.01563	0.01655	0.00076	0.00190	0.00992	0.01830
NOX MASS / MODE	LB	0.00614	0.00628	0.00273	0.00691	0.03645	0.06592

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 3	MODE 3	MODE 5	MODE 5	MODE 5	MODE 5
CAL. FUEL AIR RATIO	LB/LB	0.07086	0.06584	0.09535	0.08627	0.07402	0.06695
DIFF. CALC & MEAS F/A	PERCENT	19.01	19.08	8.23	9.55	7.77	9.67
DIFF EV & CB RATE	PERCENT	3.19	2.80	0.46	1.24	1.11	1.21
SUM OF MOLE FRACTIONS		1.12053	1.08155	1.06011	1.07987	1.05584	1.04551

C-200-A S/N 251950 (RERUN) TEST 4 IND AIR PRES VAR RUNS 32-38 08/05/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3		PERCENT
30.067	86.50	77.00	2.1250	86.50	100.00	201.00	3.000 5.550	1.753

	UNITS	MODE 1	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2
RUN NUMBER	--	32.	33.	34.	35.	36.	37.	38.
TIME IN MODE	MINUTES	1.00	1.00	1.00	1.00	11.00	11.00	11.00
FUEL FLOW	LB/HR	3.80	3.60	3.50	3.40	9.00	8.80	9.00
INDUCTION AIR FLOW (W)	LB/HR	40.00	41.90	46.70	48.00	101.30	99.97	102.50
HYDROCARBON CONC.	PPM-C W	42000.00	49500.00	43500.00	46500.00	7500.00	7650.00	7200.00
OXIDES OF NITROGEN CONC	PPM W	2.50	2.25	2.25	2.25	17.50	15.60	18.00
CARBON MONOXIDE CONC.	PERCENT	8.05	8.65	8.95	7.55	10.80	11.15	11.15
CARBON DIOXIDE CONC.	PERCENT	6.25	5.75	6.10	5.95	7.50	7.25	7.25
OXYGEN CONC.	PERCENT	4.25	5.25	4.50	5.00	1.25	1.25	1.25
WET CORRECTION FACTOR	--	0.87622	0.83596	0.83596	0.83596	0.84678	0.84048	0.84056
PROP. TORQUE	FT-LB	10.00	10.00	10.00	10.00	36.00	36.00	36.00
PROP. SPEED	RPM	600.00	600.00	600.00	600.00	1200.00	1200.00	1200.00
MFLD PRESSURE	IN HG ABS DRY	12.60	12.80	13.00	13.20	11.80	11.90	12.00
INDUCTION AIR TEMP	DEG F	85.00	84.00	85.00	85.00	90.00	90.00	90.00
COOLING AIR TEMP	DEG F	90.00	90.00	90.00	90.00	96.00	96.00	95.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX CYL HEAD TEMP	DEG F	282.00	325.00	343.00	355.00	340.00	388.00	406.00
EXHAUST GAS TEMP	DEG F	210.00	270.00	280.00	305.00	370.00	420.00	425.00
INDUCTION F/A RATIO (D)	LB/LB	0.09669	0.08745	0.07628	0.07210	0.09043	0.08960	0.08937
IND. F/A EQUIV. RATIO	--	1.45	1.31	1.14	1.08	1.35	1.34	1.34
ENGINE OBSERVED POWER	HP	1.14	1.14	1.14	1.14	8.21	8.23	8.23
CBS BMEP	PSI	7.50	7.50	7.50	7.50	27.01	27.01	27.01
CBS BSFC	LBM/BHP-HR	3.326	3.151	3.064	2.976	1.094	1.070	1.094
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.93525	1.02844	0.88161	0.97269	0.40735	0.40667	0.39250
BRAKE SPECIFIC HC	LBM/BHP-HR	0.81869	0.90023	0.77170	0.85143	0.04952	0.04944	0.04772
HC MASS / MODE	LB	0.01559	0.01714	0.01469	0.01621	0.07468	0.07456	0.07196
CO EMISSION RATE	LB/HR	3.17098	3.03293	3.06115	2.66528	10.02729	10.05694	10.31415
BRAKE SPECIFIC CO	LBM/BHP-HR	2.77567	2.65482	2.67953	2.33301	1.21906	1.22266	1.25393
CO MASS / MODE	LB	0.05285	0.05055	0.05102	0.04442	1.83834	1.84377	1.89093
NOX EMISSION RATE	LB/HR	0.00018	0.00016	0.00015	0.00016	0.00315	0.00275	0.00325
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00016	0.00014	0.00013	0.00014	0.00038	0.00033	0.00040
NOX MASS / MODE	LB	0.00000	0.00000	0.00000	0.00000	0.00058	0.00050	0.00060
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09746	0.10074	0.10024	0.09774	0.09346	0.09484	0.09458
DIFF. CALC & MEAS F/A	PERCENT	0.80	15.19	31.40	35.57	3.35	5.85	5.83
DIFF EV & CB RATE	PERCENT	0.05	0.29	3.39	3.61	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.00765	1.05264	1.20556	1.18074	1.05248	1.05779	1.05749

C-200-A S/N 251950 (RERUN) TEST 4A IND AIR PRES VAR RUNS 39-45 08/05/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.067	86.50	77.00	2.1250	86.50	100.00	201.00	3.000 5.550	1.753

	UNITS	MODE 2	MODE 3	MODE 3	MODE 3	MODE 3	MODE 3	MODE 5
RUN NUMBER	--	39.	40.	41.	42.	43.	44.	45.
TIME IN MODE	MINUTES	11.00	0.30	0.30	0.30	0.30	0.30	6.00
FUEL FLOW	LB/HR	8.50	44.00	44.00	45.00	45.00	46.00	26.00
INDUCTION AIR FLOW (W)	LB/HR	99.60	566.40	575.60	590.30	595.10	623.40	301.10
HYDROCARBON CONC.	PPM-C W	7350.00	3675.00	3525.00	3375.00	3150.00	3000.00	5250.00
OXIDES OF NITROGEN CONC	PPM W	17.00	112.50	130.00	150.00	187.00	195.00	49.00
CARBON MONOXIDE CONC.	PERCENT	11.15	10.00	9.60	9.30	8.90	8.60	11.30
CARBON DIOXIDE CONC.	PERCENT	7.25	8.85	8.95	9.25	9.55	9.60	7.80
OXYGEN CONC.	PERCENT	1.25	0.25	0.25	0.25	0.25	0.25	0.50
WET CORRECTION FACTOR	--	0.83596	0.83596	0.83596	0.83596	0.83596	0.83596	0.83596
PROP. TORQUE	FT-LB	35.00	158.00	160.00	160.00	160.00	153.00	83.00
PROP. SPEED	RPM	1200.00	2400.00	2400.00	2410.00	2440.00	2450.00	19500.00
MFLD PRESSURE	IN HG ABS DRY	11.90	28.00	28.40	28.90	29.40	29.90	20.00
INDUCTION AIR TEMP	DEG F	90.00	93.00	93.00	93.00	93.00	94.00	93.00
COOLING AIR TEMP	DEG F	95.00	103.00	103.00	103.00	103.00	103.00	103.00
COOLING AIR DELTA P	IN H2O	0.0	4.30	4.30	4.30	4.30	4.30	4.30
MAX CYL HEAD TEMP	DEG F	415.00	463.00	475.00	487.00	475.00	498.00	370.00
EXHAUST GAS TEMP	DEG F	410.00	1010.00	1020.00	1035.00	0.0	0.0	0.0
INDUCTION F/A RATIO (D)	LB/LB	0.08686	0.07907	0.07781	0.07759	0.07697	0.07511	0.08789
IND. F/A EQUIV. RATIO	--	1.30	1.18	1.16	1.16	1.15	1.12	1.31
ENGINE OBSERVED POWER	HP	8.00	72.20	73.11	73.42	74.33	71.37	308.17
OBS BMEP	PSI	26.26	118.54	120.04	120.04	120.04	114.79	62.27
OBS BSFC	LBM/BHP-HR	1.063	0.609	0.602	0.613	0.605	0.645	0.084

CARBON BALANCE MASS EMISSIONS

HC EMISSION RATE	LB/HR	0.38005	0.98312	0.95880	0.93975	0.88301	0.87207	0.81147
BRAKE SPECIFIC HC	LBM/BHP-HR	0.04752	0.01362	0.01311	0.01280	0.01188	0.01222	0.00263
HC MASS / MODE	LB	0.06968	0.00492	0.00479	0.00470	0.00442	0.00436	0.08115
CO EMISSION RATE	LB/HR	9.72970	45.14651	44.06700	43.70148	42.10376	42.18910	29.47566
BRAKE SPECIFIC CO	LBM/BHP-HR	1.21668	0.62529	0.60271	0.59523	0.56642	0.59111	0.09565
CO MASS / MODE	LB	1.78378	0.22573	0.22033	0.21851	0.21052	0.21095	2.94757
NOX EMISSION RATE	LB/HR	0.00291	0.09580	0.11725	0.13850	0.17382	0.18796	0.02511
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00036	0.00138	0.00160	0.00189	0.00234	0.00263	0.00008
NOX MASS / MODE	LB	0.00053	0.00050	0.00059	0.00069	0.00087	0.00094	0.00251

** DATA VALIDITY CHECKS FOR ENGLO7 **

CAL. FUEL AIR RATIO	LB/LB	0.09469	0.09122	0.09025	0.08908	0.08774	0.08705	0.09570
DIFF. CALC & MEAS F/A	PERCENT	9.01	15.37	15.99	14.80	13.99	15.90	8.88
DIFF EV & CB RATE	PERCENT	0.40	2.44	2.52	2.42	2.36	2.67	0.77
SUM OF MOLE FRACTIONS		1.07347	1.14480	1.13915	1.14056	1.13987	1.14384	1.08670

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C-200-A S/N 251950 (RERUN) TEST 4B IND AIR PRES VAR RUNS 46-48 08/05/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.067	86.50	77.00	2.1250	86.50	100.00	201.00	3.000	5.550	1.1753

	UNITS	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	46.	47.	48.				
TIME IN MODE	MINUTES	6.00	6.00	6.00				
FUEL FLOW	LB/HR	26.00	26.00	26.00				
INDUCTION AIR FLOW (W)	LB/HR	306.60	302.20	311.20				
HYDROCARBON CONC.	PPM-C W	5250.00	5250.00	5025.00				
OXIDES OF NITROGEN CONC	PPM W	49.00	48.00	53.00				
CARBON MONOXIDE CONC.	PERCENT	11.20	11.15	10.95				
CARBON DIOXIDE CONC.	PERCENT	7.90	7.90	7.95				
OXYGEN CONC.	PERCENT	0.50	0.50	0.50				
WET CORRECTION FACTOR	--	0.83596	0.83596	0.83596				
PROP. TORQUE	FT-LB	55.00	40.00	35.00				
PROP. SPEED	RPM	1950.00	1950.00	1950.00				
FIELD PRESSURE	IN HG ABS DRY	19.70	19.50	19.70				
INDUCTION AIR TEMP	DEG F	92.00	92.00	92.00				
COOLING AIR TEMP	DEG F	102.00	103.00	103.00				
COOLING AIR DELTA P	IN H2O	4.30	4.30	4.30				
MAX CYL HEAD TEMP	DEG F	356.00	353.00	356.00				
EXHAUST GAS TEMP	DEG F	0.0	0.0	0.0				
INDUCTION F/A RATIO (D)	LB/LB	0.08631	0.08757	0.08504				
IND. F/A EQUIV. RATIO	—	1.29	1.31	1.27				
ENGINE OBSERVED POWER	HP	20.42	14.85	13.00				
OBS BMEP	PSI	41.26	30.01	26.26				
OBS BSFC	LBM/BHP-HR	1.273	1.751	2.001				

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 5	MODE 5	MODE 5
HC EMISSION RATE	LB/HR	0.81147	0.81353	0.78573
BRAKE SPECIFIC HC	LBM/BHP-HR	0.03974	0.05478	0.06046
HC MASS / MODE	LB	0.08115	0.08135	0.07857
CO EMISSION RATE	LB/HR	29.21481	29.15828	28.89505
BRAKE SPECIFIC CO	LBM/BHP-HR	1.43064	1.96332	2.22354
CO MASS / MODE	LB	2.92148	2.91583	2.88950
NOX EMISSION RATE	LB/HR	0.02511	0.02466	0.02748
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00123	0.00166	0.00211
NOX MASS / MODE	LB	0.00251	0.00247	0.00275

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 5	MODE 5	MODE 5
CAL. FUEL AIR RATIO	LB/LB	0.09527	0.09518	0.09458
DIFF. CALC & MEAS F/A	PERCENT	10.37	8.69	11.22
DIFF EV & CB RATE	PERCENT	1.12	0.77	1.26
SUM OF MOLE FRACTIONS		1.10041	1.08607	1.09941

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C-200-A S/N 251950 (RERUN) TEST 5 BASELINE RUNS 53-58 08/06/76

PBARC	IDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C – H FORMULA		PERCENT
30.060	88.00	79.00	2.1250	88.00	100.00	201.00	1.000	5.550	1.900

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	53.	54.	55.	55.	56.	57.	58.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.60	9.00	45.00	45.00	25.80	8.80	3.60	
INDUCTION AIR FLOW (W)	LB/HR	45.27	108.20	605.70	605.70	307.46	108.50	45.20	
HYDROCARBON CONC.	PPM-C W	51000.00	7800.00	3075.00	3075.00	9025.00	7950.00	41250.00	
OXIDES OF NITROGEN CONC	PPM W	2.25	13.75	200.00	200.00	55.00	15.00	3.00	
CARBON MONOXIDE CONC.	PERCENT	8.65	11.15	8.55	8.55	10.95	11.10	9.80	
CARBON DIOXIDE CONC.	PERCENT	5.80	7.35	9.65	9.65	8.10	7.35	6.10	
OXYGEN CONC.	PERCENT	5.50	1.25	0.25	0.25	0.38	1.25	4.00	
WET CORRECTION FACTOR	--	0.83352	0.83352	0.83352	0.83352	0.83352	0.83352	0.83352	
PROP. TORQUE	FT-LB	10.00	35.00	170.00	170.00	96.00	35.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2430.00	2430.00	1950.00	1200.00	600.00	
MELD PRESSURE	IN HG ABS DRY	12.90	12.00	29.30	29.30	19.60	11.80	12.70	
INDUCTION AIR TEMP	DEG F	85.00	85.00	89.00	89.00	88.00	88.00	87.00	
COOLING AIR TEMP	DEG F	90.00	89.00	97.00	97.00	99.00	95.00	95.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.40	3.40	3.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	318.00	385.00	485.00	485.00	367.00	363.00	383.00	
EXHAUST GAS TEMP	DEG F	305.00	420.00	1050.00	775.00	465.00	350.00	0.0	
INDUCTION F/A RATIO (D)	LB/LB	0.08106	0.08479	0.07573	0.07573	0.08554	0.08268	0.08119	0.08270 TA
IND. F/A EQUIV. RATIO	--	1.21	1.27	1.13	1.13	1.28	1.24	1.21	1.24 TA
ENGINE OBSERVED POWER	HP	1.14	8.00	78.66	78.66	35.64	8.00	1.14	
CBS BMEP	PSI	7.50	26.26	127.54	127.54	72.02	26.26	7.50	
CBS BSFC	LBM/BHP-HR	3.151	1.125	0.572	0.572	0.724	1.100	3.151	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.04993	0.42484	0.87653	0.87653	0.77593	0.42409	0.83779	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.91904	0.05313	0.01114	0.01114	0.02177	0.05303	0.73335	
HC MASS / MODE	LB	0.01750	0.07789	0.00438	0.07304	0.07759	0.02120	0.01396	0.28557
HC MASS / RATED HP	LB/HP								0.00286
HC – PERCENT OF EPA STANDARD									150.30
CO EMISSION RATE	LB/HR	2.99646	10.21904	41.00975	41.00975	28.45134	9.96355	3.34920	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.62290	1.27787	0.52138	0.52138	0.79822	1.24592	2.93166	
CO MASS / MODE	LB	0.04994	1.87349	0.20505	3.41748	2.84513	0.49818	0.05582	8.94509
CO MASS / RATED HP	LB/HP								0.08945
CO – PERCENT OF EPA STANDARD									212.98
NOX EMISSION RATE	LB/HR	0.00015	0.00248	0.18904	0.18904	0.02816	0.00265	0.00020	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00013	0.00031	0.00240	0.00240	0.00079	0.00033	0.00018	
NOX MASS / MODE	LB	0.00000	0.00046	0.00095	0.01575	0.00282	0.00013	0.00000	0.02011
NOX MASS / RATED HP	LB/HP								0.00020
NOX– PERCENT OF EPA STANDARD									13.41
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10035	0.09471	0.08693	0.08693	0.09478	0.09471	0.10278	0.09371 TA
DIFF. CALC & MEAS F/A	PERCENT	23.75	11.70	14.78	14.78	10.80	14.55	26.60	13.33 TA
DIFF EV & CB RATE	PERCENT	1.94	0.99	2.45	2.45	1.24	1.53	2.72	
SUM OF MOLE FRACTIONS		1.16695	1.05882	1.13660	1.13660	1.10148	1.11634	1.18502	

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C-200-A S/N 251950 (RERUN) TEST 6 LEAN OLT RUNS 59-65 08/06/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C — H FORMULA		PERCENT
30.043	87.00	79.00	2.1250	87.00	100.00	201.00	3.000	5.590	1.423

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
RUN NUMBER	--	59.	60.	61.	62.	63.	64.	65.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	11.00	0.30	0.30
FUEL FLOW	LB/HR	3.60	3.40	9.00	7.80	6.10	45.00	40.00
INDUCTION AIR FLOW (W)	LB/HR	47.30	45.96	110.20	104.50	104.50	602.10	597.00
HYDROCARBON CONC.	PPM-C W	45000.00	39000.00	8100.00	5400.00	4800.00	3225.00	2325.00
OXIDES OF NITROGEN CONC	PPM W	3.25	3.25	13.25	32.00	150.00	170.00	850.00
CARBON MONOXIDE CONC.	PERCENT	8.80	8.75	10.95	9.45	2.55	8.75	4.85
CARBON DIOXIDE CONC.	PERCENT	6.25	6.45	7.45	8.35	12.45	11.80	11.50
OXYGEN CONC.	PERCENT	4.75	4.37	1.13	1.13	1.13	0.25	0.25
WET CORRECTION FACTOR	--	0.83314	0.83314	0.83314	0.83314	0.83314	0.83314	0.83314
PROP. TORQUE	FT-LB	10.00	10.00	35.00	35.00	33.00	165.00	166.00
PROP. SPEED	RPM	600.00	600.00	1200.00	1200.00	1200.00	2435.00	2450.00
MFLD PRESSURE	IN HG ABS DRY	12.60	12.50	11.90	11.90	12.00	29.30	29.40
INDUCTION AIR TEMP	DEG F	89.00	88.00	89.00	88.00	88.00	91.00	93.00
COOLING AIR TEMP	DEG F	92.00	92.00	92.00	92.00	92.00	98.00	100.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	4.30	4.30
MAX CYL HEAD TEMP	DEG F	243.00	320.00	320.00	393.00	416.00	495.00	511.00
EXHAUST GAS TEMP	DEG F	380.00	275.00	440.00	420.00	425.00	1050.00	1100.00
INDUCTION F/A RATIO (D)	LB/LB	0.07760	0.07543	0.08327	0.07610	0.05952	0.07620	0.06832
IND. F/A EQUIV. RATIO	--	1.16	1.13	1.25	1.14	0.89	1.14	1.02
ENGINE OBSERVED POWER	HP	1.14	1.14	8.00	8.00	7.54	76.50	77.44
OBS BMEP	PSI	7.50	7.50	26.26	26.26	24.76	123.79	124.54
OBS BSFC	LBM/BHP-HR	3.151	2.976	1.125	0.975	0.809	0.588	0.517

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
HC EMISSION RATE	LB/HR	0.93215	0.78486	0.44283	0.26867	0.22121	0.81567	0.65812
BRAKE SPECIFIC HC	LBM/BHP-HR	0.81594	0.68702	0.05537	0.03360	0.02934	0.01066	0.00850
HC MASS / MODE	LB	0.01554	0.01308	0.08119	0.04926	0.04055	0.00408	0.00329
CO EMISSION RATE	LB/HR	3.06592	2.96171	10.06868	7.90804	1.97654	37.22198	23.09029
BRAKE SPECIFIC CO	LBM/BHP-HR	2.68370	2.59248	1.25906	0.98888	0.26214	0.48657	0.29818
CO MASS / MODE	LB	0.05110	0.04936	1.84592	1.44981	0.36237	0.18611	0.11545
NOX EMISSION RATE	LB/HR	0.00022	0.00022	0.00240	0.00528	0.02292	0.14257	0.79782
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00020	0.00019	0.00030	0.00066	0.00304	0.00186	0.01030
NOX MASS / MODE	LB	0.00000	0.00000	0.00044	0.00097	0.00420	0.00071	0.00399

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
CAL. FUEL AIR RATIO	LB/LB	0.09933	0.09696	0.09484	0.08857	0.07133	0.08436	0.07772
DIFF. CALC & MEAS F/A	PERCENT	28.00	28.55	13.89	16.38	19.85	10.70	13.76
DIFF EV & CB RATE	PERCENT	2.94	3.12	1.42	2.19	3.30	2.98	2.28
SUM OF MOLE FRACTIONS		1.20085	1.19757	1.10750	1.12858	1.14480	1.27578	1.09872

C-200-A S/N 251950 (RERUN) TEST 7 LEAN OLT RUNS 66-71 08/06/76

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.043	87.00	79.00	2.1250	87.00	100.00	201.00	3.000 5.550	1.923

	UNITS	MODE 3	MODE 3	MODE 5	MODE 5	MODE 5	MODE 5	MODE 0
RUN NUMBER	--	66.	67.	68.	69.	70.	71.	
TIME IN MODE	MINUTES	0.30	0.30	6.00	6.00	6.00	6.00	
FUEL FLOW	LB/HR	35.00	33.80	26.00	23.00	20.00	17.50	
INDUCTION AIR FLOW (W)	LB/HR	595.70	608.10	302.80	303.30	308.10	307.60	
HYDROCARBON CONC.	PPM-C W	1740.00	590.00	5250.00	3675.00	2700.00	1050.00	
OXIDES OF NITROGEN CONC	PPM W	1625.00	2500.00	47.50	168.75	490.00	1300.00	
CARBON MONOXIDE CONC.	PERCENT	2.15	0.25	11.00	7.45	4.40	0.45	
CARBON DIOXIDE CONC.	PERCENT	13.00	13.65	7.90	10.00	11.55	13.25	
OXYGEN CONC.	PERCENT	0.25	0.75	0.38	0.38	0.38	1.13	
WET CORRECTION FACTOR	--	0.83314	0.83314	0.83314	0.83314	0.83314	0.83314	
PROP. TORQUE	FT-LB	166.00	157.00	90.00	93.00	96.00	89.00	
PROP. SPEED	RPM	2440.00	2420.00	1950.00	1950.00	1950.00	1950.00	
MFLD PRESSURE	IN HG ABS DRY	29.40	29.40	19.70	19.50	19.60	20.10	
INDUCTION AIR TEMP	DEG F	95.00	92.00	90.00	90.00	89.00	89.00	
COOLING AIR TEMP	DEG F	101.00	100.00	97.00	96.00	96.00	97.00	
COOLING AIR DELTA P	IN H2O	4.30	4.30	4.30	4.30	4.30	4.30	
MAX CYL HEAD TEMP	DEG F	513.00	463.00	360.00	380.00	404.00	395.00	
EXHAUST GAS TEMP	DEG F	1155.00	1175.00	775.00	790.00	830.00	895.00	
INDUCTION F/A RATIO (D)	LB/LB	0.05991	0.05667	0.08755	0.07732	0.06619	0.05801	
IND. F/A EQUIV. RATIO	--	0.90	0.85	1.31	1.16	0.99	0.87	
ENGINE OBSERVED POWER	HP	77.12	72.34	33.42	34.53	35.64	33.04	
CBS BMEP	PSI	124.54	117.79	67.52	69.77	72.02	66.77	
CBS BSFC	LBM/BHP-HR	0.454	0.467	0.778	0.666	0.561	0.530	
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.46660	0.28089	0.82246	0.55595	0.39047	0.15639	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00605	0.00388	0.02461	0.01610	0.01095	0.00473	
HC MASS / MODE	LB	0.00233	0.00140	0.08225	0.05560	0.03905	0.01564	
CO EMISSION RATE	LB/HR	9.69713	1.19300	28.98381	18.95581	10.70241	1.12732	
BRAKE SPECIFIC CO	LBM/BHP-HR	0.12574	0.01649	0.86737	0.54897	0.30026	0.03412	
CO MASS / MODE	LB	0.04849	0.00596	2.89838	1.89558	1.07024	0.11273	
NOX EMISSION RATE	LB/HR	1.44497	2.35202	0.02468	0.08465	0.23498	0.64207	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.01874	0.03251	0.00074	0.00245	0.00659	0.01943	
NOX MASS / MODE	LB	0.00722	0.01176	0.00247	0.00847	0.02350	0.06421	
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.07151	0.06569	0.09550	0.08432	0.07662	0.06497	
DIFF. CALC & MEAS F/A	PERCENT	19.37	15.91	9.08	9.06	15.76	12.01	
DIFF. EV & CB RATE	PERCENT	3.24	2.25	0.75	1.26	2.56	1.42	
SUM OF MOLE FRACTIONS		1.12158	1.07419	1.07653	1.07874	1.10113	1.04315	

C-200-A S/N 251950 (RERUN) TEST 8 BASELINE RUNS 95-100 08/17/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.065	78.50	74.00	2.1250	78.50	100.00	201.00	3.000 5.550	1.875

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	95.	96.	97.	97.	98.	99.	100.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.70	9.30	45.50	45.50	25.00	8.50	3.50	
INDUCTION AIR FLOW (W)	LB/HR	45.30	109.00	603.80	603.80	306.90	101.60	44.40	
HYDROCARBON CONC.	PPM-C W	48000.00	7800.00	2925.00	2925.00	5025.00	8550.00	40500.00	
OXIDES OF NITROGEN CONC	PPM W	3.25	14.75	218.75	218.75	53.75	10.06	2.25	
CARBON MONOXIDE CONC.	PERCENT	9.15	11.10	8.30	8.30	10.90	11.25	9.45	
CARBON DIOXIDE CONC.	PERCENT	5.85	7.15	9.75	9.75	7.95	7.05	6.10	
OXYGEN CONC.	PERCENT	4.75	1.37	0.25	0.25	0.50	1.37	4.25	
WET CORRECTION FACTOR	--	0.83724	0.83724	0.83724	0.83724	0.83724	0.83724	0.83724	
PROP. TORQUE	FT-LB	10.00	35.00	163.00	163.00	97.00	33.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2435.00	2435.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.00	12.20	29.30	29.30	19.80	11.70	12.00	
INDUCTION AIR TEMP	DEG F	80.00	80.00	83.00	83.00	84.00	83.00	83.00	
COOLING AIR TEMP	DEG F	85.00	83.00	91.00	91.00	93.00	90.00	90.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.40	3.40	3.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	316.00	376.00	498.00	498.00	360.00	343.00	355.00	
EXHAUST GAS TEMP	DEG F	360.00	405.00	1050.00	1050.00	770.00	475.00	300.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08307	0.08677	0.07664	0.07664	0.08285	0.08509	0.08017	0.08338 TA
IND. F/A EQUIV. RATIO	--	1.24	1.30	1.15	1.15	1.24	1.27	1.20	1.25 TA
ENGINE OBSERVED POWER	HP	1.14	8.00	75.57	75.57	36.01	7.54	1.14	
OBS BMEP	PSI	7.50	26.26	122.29	122.29	72.77	24.76	7.50	
OBS BSFC	LBM/BHP-HR	3.239	1.163	0.602	0.602	0.694	1.127	3.064	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.00308	0.44284	0.84702	0.84702	0.75633	0.44046	0.81418	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.87803	0.05538	0.01121	0.01121	0.02100	0.05842	0.71268	
HC MASS / MODE	LB	0.01672	0.08119	0.00424	0.07058	0.07563	0.02202	0.01357	0.28395
HC MASS / RATED HP	LB/HP								0.00284
HC - PERCENT OF EPA STANDARD									149.45
CO EMISSION RATE	LB/HR	3.23187	10.65162	40.62392	40.62392	27.72922	9.79563	3.21096	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.82896	1.33196	0.53755	0.53755	0.76994	1.29916	2.81066	
CO MASS / MODE	LB	0.05386	1.95280	0.20312	3.38533	2.77292	0.48978	0.05352	8.91132
CO MASS / RATED HP	LB/HP								0.08911
CO - PERCENT OF EPA STANDARD									212.17
NOX EMISSION RATE	LB/HR	0.00023	0.00278	0.21005	0.21005	0.02683	0.00172	0.00015	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00020	0.00035	0.00278	0.00278	0.00074	0.00023	0.00013	
NOX MASS / MODE	LB	0.00000	0.00051	0.00105	0.01750	0.00268	0.00009	0.00000	0.02184
NOX MASS / RATED HP	LB/HP								0.00022
NOX- PERCENT OF EPA STANDARD									14.56
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10274	0.09457	0.08624	0.08624	0.09449	0.09555	0.10045	0.09356 TA
DIFF. CALC & MEAS F/A	PERCENT	23.68	8.99	12.53	12.53	14.05	12.30	25.30	12.21 TA
DIFF EV & CB RATE	PERCENT	2.00	0.34	2.07	2.07	1.81	0.96	2.49	
SUM OF MOLE FRACTIONS		1.15610	1.06956	1.11816	1.11816	1.11723	1.09093	1.17362	

C-23

C-200-A S/N 251950 (RERUN) TEST 9 BASELINE RUNS 101-106 08/17/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.052	85.00	75.00	2.1250	85.00	100.00	201.00	3.000	5.550	1.613

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	101.	102.	103.	103.	104.	105.	106.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.70	9.00	45.00	45.00	25.50	8.80	3.80	
INDUCTION AIR FLOW (W)	LB/HR	44.25	107.60	597.35	597.35	300.83	105.20	44.25	
HYDROCARBON CONC.	PPM-C W	48750.00	7500.00	2850.00	2850.00	5250.00	7800.00	41250.00	
OXIDES OF NITROGEN CONC	PPM W	2.50	15.00	212.50	212.50	52.50	13.25	2.13	
CARBON MONOXIDE CONC.	PERCENT	8.90	5.60	8.60	8.60	11.10	11.10	9.55	
CARBON DIOXIDE CONC.	PERCENT	5.85	7.25	9.65	9.65	7.80	7.15	6.00	
OXYGEN CONC.	PERCENT	5.13	1.38	0.25	0.25	0.50	1.38	4.38	
WET CORRECTION FACTOR	--	0.83827	0.84358	0.83827	0.83827	0.83827	0.83827	0.83827	
PROP. TORQUE	FT-LB	10.00	33.00	164.00	164.00	92.00	32.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2435.00	2435.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	12.50	12.10	29.30	29.30	19.50	11.60	12.50	
INDUCTION AIR TEMP	DEG F	85.00	83.00	88.00	88.00	89.00	88.00	85.00	
COOLING AIR TEMP	DEG F	93.00	90.00	100.00	100.00	100.00	101.00	95.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.40	3.40	3.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	291.00	375.00	510.00	510.00	350.00	340.00	365.00	
EXHAUST GAS TEMP	DEG F	420.00	410.00	1050.00	1050.00	765.00	470.00	300.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08499	0.08501	0.07657	0.07657	0.08616	0.08502	0.08728	0.08371 TA
IND. F/A EQUIV. RATIO	--	1.27	1.27	1.15	1.15	1.29	1.27	1.31	1.25 TA
ENGINE OBSERVED POWER	HP	1.14	7.54	76.04	76.04	34.16	7.31	1.14	
OBS BMEP	PSI	7.50	24.76	123.04	123.04	69.02	24.01	7.50	
OBS BSFC	LBM/BHP-HR	3.239	1.194	0.592	0.592	0.747	1.204	3.326	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.02575	0.44224	0.60687	0.60687	0.80187	0.41854	0.89556	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.89751	0.05865	0.01061	0.01061	0.02348	0.05724	0.78392	
HC MASS / MODE	LB	0.01710	0.08108	0.00403	0.06724	0.08019	0.02093	0.01493	0.28549
HC MASS / RATED HP	LB/HP								0.00285
HC - PERCENT OF EPA STANDARD									150.26
CO EMISSION RATE	LB/HR	3.16918	9.64602	41.20284	41.20284	28.69054	10.07955	3.50870	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.77405	1.27852	0.54189	0.54189	0.83993	1.37859	3.07128	
CO MASS / MODE	LB	0.05282	1.76734	0.20601	3.43357	2.86905	0.50398	0.05848	8.89125
CO MASS / RATED HP	LB/HP								0.08891
CO - PERCENT OF EPA STANDARD									211.70
NOX EMISSION RATE	LB/HR	0.00017	0.00293	0.19949	0.19949	0.02659	0.00236	0.00015	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00015	0.00039	0.00262	0.00262	0.00078	0.00032	0.00013	
NOX MASS / MODE	LB	0.00000	0.00054	0.00100	0.01662	0.00266	0.00012	0.00000	0.02094
NOX MASS / RATED HP	LB/HP								0.00021
NOX- PERCENT OF EPA STANDARD									13.96
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10092	0.05126	0.08688	0.08688	0.09534	0.09454	0.10073	0.09237 TA
DIFF. CALC & MEAS F/A	PERCENT	18.74	7.35	13.47	13.47	10.66	11.20	15.41	10.35 TA
DIFF EV & CB RATE	PERCENT	1.13	0.05	2.28	2.28	1.11	0.80	0.68	
SUM OF MOLE FRACTIONS		1.13015	1.01053	1.13102	1.13102	1.09139	1.08517	1.10927	

C-200-A S/N 251950 (REPUN) TEST 10 BASELINE RUNS 107-112 08/17/76

C-24

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.052	85.00	75.00	2.1250	85.00	100.00	201.00	3.000 5.550	1.613

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	107.	108.	109.	109.	110.	111.	112.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	3.60	8.60	45.00	45.00	26.00	8.60	3.60	
INDUCTION AIR FLOW (W)	LB/HR	46.10	101.90	603.50	603.50	299.98	105.60	41.10	
HYDROCARBON CONC.	PPM-C W	42000.00	7550.00	3000.00	3000.00	5025.00	7500.00	56250.00	
OXIDES OF NITROGEN CONC	PPM W	2.25	13.50	200.00	200.00	53.75	14.00	2.13	
CARBON MONOXIDE CONC.	PERCENT	8.95	11.00	8.60	8.60	11.00	11.10	8.90	
CARBON DIOXIDE CONC.	PERCENT	6.25	7.01	9.55	9.55	7.80	7.15	6.01	
OXYGEN CONC.	PERCENT	4.38	1.50	0.25	0.25	0.50	1.38	5.75	
WET CORRECTION FACTOR	--	0.83827	0.83827	0.83827	0.83827	0.83827	0.83827	0.83827	
FROP. TORQUE	FT-LB	10.00	32.00	165.00	165.00	92.00	32.00	10.00	
FROP. SPEED	RPM	600.00	1200.00	2435.00	2435.00	1950.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	12.50	11.60	29.30	29.30	19.60	11.60	12.70	
INDUCTION AIR TEMP	DEG F	88.00	88.00	88.00	88.00	89.00	88.00	88.00	
COOLING AIR TEMP	DEG F	95.00	95.00	100.00	100.00	101.00	98.00	98.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.40	3.40	3.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	281.00	362.00	490.00	490.00	371.00	348.00	370.00	
EXHAUST GAS TEMP	DEG F	350.00	385.00	1050.00	1050.00	770.00	455.00	275.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07937	0.08578	0.07579	0.07579	0.08809	0.08277	0.08903	0.08390 TA
IND. F/A EQUIV. RATIO	--	1.19	1.28	1.13	1.13	1.32	1.24	1.33	1.26 TA
ENGINE OBSERVED POWER	HP	1.14	7.31	76.50	76.50	34.16	7.31	1.14	
OBS BMEP	PSI	7.50	24.01	123.79	123.79	69.02	24.01	7.50	
OBS BSFC	LBM/BHP-HR	3.151	1.176	0.588	0.588	0.761	1.176	3.151	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.87499	0.42178	0.85310	0.85310	0.78767	0.39404	1.09544	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.76591	0.05769	0.01115	0.01115	0.02306	0.05389	0.95888	
HC MASS / MODE	LB	0.01458	0.07733	0.00427	0.07109	0.07877	0.01970	0.01826	0.28399
HC MASS / RATED HP	LB/HP								0.00284
HC - PERCENT OF EPA STANDARD									149.47
CO EMISSION RATE	LB/HR	3.15535	5.87609	41.38562	41.38562	29.17911	9.86889	2.93310	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.76198	1.35076	0.54099	0.54099	0.85423	1.34978	2.56746	
CO MASS / MODE	LB	0.05259	1.81062	0.20693	3.44880	2.91791	0.49344	0.04889	8.97917
CO MASS / RATED HP	LB/HP								0.08979
CO - PERCENT OF EPA STANDARD									213.79
NOX EMISSION RATE	LB/HR	0.00016	0.00237	0.18859	0.18859	0.02794	0.00244	0.00014	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00014	0.00032	0.00247	0.00247	0.00082	0.00033	0.00012	
NOX MASS / MODE	LB	0.00000	0.00044	0.00094	0.01572	0.00279	0.00012	0.00000	0.02001
NOX MASS / RATED HP	LB/HP								0.00020
NOX- PERCENT OF EPA STANDARD									13.34

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09944	0.09424	0.08713	0.08713	0.09504	0.09437	0.10176	0.09352 TA
DIFF. CALC & MEAS F/A	PERCENT	25.28	9.87	14.96	14.96	7.88	14.01	14.30	11.46 TA
DIFF EV & CB RATE	PERCENT	2.50	0.41	2.49	2.49	0.52	1.35	0.53	
SUM OF MOLE FRACTIONS		1.17078	1.06681	1.13409	1.13409	1.06807	1.10407	1.14461	

APPENDIX D. IO-520-D TEST DATA

IO-520-D S/N 559025 TEST 1 BASELINE 22 DEG BTC RUNS 1-7 02/24/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.989	44.50	39.00	2.1250	49.00	300.00	520.00	3.000	5.550	0.377

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.00	16.90	146.00	105.00	77.50	16.90	7.50	
INDUCTION AIR FLOW (W)	LB/HR	65.00	162.00	1795.00	1325.00	845.00	162.50	62.00	
HYDROCARBON CONC.	PPM-C W	70200.00	20500.00	1375.00	850.00	1750.00	20500.00	70000.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	40.00	290.00	320.00	100.00	35.00	25.00	
CARBON MONOXIDE CONC.	PERCENT	4.85	5.45	7.55	7.25	10.50	9.05	5.05	
CARBON DIOXIDE CONC.	PERCENT	6.25	7.65	9.55	9.75	7.85	7.95	5.95	
OXYGEN CONC.	PERCENT	7.25	1.62	0.38	0.50	0.38	1.37	7.50	
WET CORRECTION FACTOR	--	0.99562	0.90574	0.85859	0.85843	0.87043	0.90386	0.99559	
PROP. TORQUE	FT-LB	10.00	37.00	540.00	436.00	257.00	38.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
FIELD PRESSURE	IN HG ABS DRY	16.50	13.50	28.60	25.00	18.00	13.50	17.00	
INDUCTION AIR TEMP	DEG F	45.00	46.00	55.00	56.00	55.00	54.00	54.00	
COOLING AIR TEMP	DEG F	0.0	0.0	64.00	65.00	67.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.40	1.40	1.40	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	335.00	385.00	460.00	440.00	362.00	365.00	360.00	
EXHAUST GAS TEMP	DEG F	320.00	690.00	1420.00	1340.00	1180.00	700.00	670.00	
INDUCTION F/A RATIO (D)	LB/LB	0.12354	0.10472	0.08165	0.07955	0.09206	0.10439	0.12143	0.09834 TA
IND. F/A EQUIV. RATIO	--	1.85	1.57	1.22	1.19	1.38	1.56	1.82	1.47 TA
ENGINE OBSERVED POWER	HP	1.14	8.45	293.08	212.94	121.36	8.68	1.14	
OBS BMEP	PSI	2.90	10.73	156.60	126.44	74.53	11.02	2.90	
OBS BSFC	LBM/BHP-HR	7.003	1.999	0.498	0.493	0.639	1.946	6.565	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	3.06003	1.93672	1.32811	0.59613	0.82347	1.95034	2.86727	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.67855	0.22909	0.00453	0.00280	0.00679	0.22463	2.50981	
HC MASS / MODE	LB	0.05100	0.35507	0.00664	0.04968	0.08235	0.09752	0.04779	0.69004
HC MASS / RATED HP	LB/HP								0.00230
HC - PERCENT OF EPA STANDARD									121.06
CO EMISSION RATE	LB/HR	4.21920	16.32425	126.40096	88.11531	86.81956	15.71059	4.15746	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.69321	1.93097	0.43136	0.41381	0.71541	1.80967	3.63916	
CO MASS / MODE	LB	0.07032	2.99278	0.63200	7.34294	8.68195	0.78553	0.06929	20.57480
CO MASS / RATED HP	LB/HP								0.06858
CO - PERCENT OF EPA STANDARD									163.29
NOX EMISSION RATE	LB/HR	0.00431	0.01253	0.92883	0.74418	0.15603	0.01104	0.00340	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00377	0.00148	0.00317	0.00349	0.00129	0.00127	0.00297	
NOX MASS / MODE	LB	0.00007	0.00230	0.00464	0.06202	0.01560	0.00055	0.00006	0.08524
NOX MASS / RATED HP	LB/HP								0.00028
NOX- PERCENT OF EPA STANDARD									18.94

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08990	0.05582	0.08379	0.08218	0.09261	0.09558	0.08938	0.09200 TA
DIFF. CALC & MEAS F/A	PERCENT	-27.23	-8.49	2.62	3.31	0.59	-8.44	-26.39	-6.44 TA
DIFF EV & CB RATE	PERCENT	-1.09	0.05	0.05	0.23	0.05	0.05	-0.99	
SUM OF MOLE FRACTIONS		0.90407	0.95536	1.01297	1.02372	1.01592	0.98798	0.50867	

D-1

IO-520-D S/N 559025 TEST 2 BASELINE 22 DEG BTC RUNS 8-14 02/24/75

EBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.934	56.00	45.00	2.1250	49.00	300.00	520.00	3.000 5.550	0.380

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.50	16.80	145.00	116.00	76.00	16.80	8.00	
INDUCTION AIR FLOW (W)	LB/HR	71.00	162.00	1795.00	1460.00	850.00	161.00	73.00	
HYDROCARBON CONC.	PPM-C W	60000.00	21000.00	1600.00	800.00	1650.00	21650.00	71400.00	
OXIDES OF NITROGEN CONC	PPM W	22.50	36.20	300.00	315.00	100.00	36.20	60.00	
CARBON MONOXIDE CONC.	PERCENT	4.80	5.75	7.25	7.25	10.30	8.90	4.40	
CARBON DIOXIDE CONC.	PERCENT	7.00	7.55	9.75	9.65	7.85	7.85	4.25	
OXYGEN CONC.	PERCENT	6.12	1.50	0.50	0.50	0.50	1.50	10.25	
WET CORRECTION FACTOR	--	0.95854	0.85825	0.86032	0.85838	0.86632	0.90624	0.99569	
PROP. TORQUE	FT-LB	10.00	37.00	539.00	493.00	258.00	38.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	17.00	13.50	28.70	27.40	18.10	13.50	17.00	
INDUCTION AIR TEMP	DEG F	50.00	51.00	62.00	60.00	60.00	56.00	54.00	
COOLING AIR TEMP	DEG F	0.0	0.0	66.00	67.00	67.00	61.00	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.60	1.60	1.60	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	315.00	390.00	457.00	450.00	363.00	350.00	287.00	
EXHAUST GAS TEMP	DEG F	370.00	690.00	1430.00	1355.00	1170.00	680.00	360.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10604	0.10410	0.08109	0.07976	0.08975	0.10475	0.11001	0.09659 TA
IND. F/A EQUIV. RATIO	--	1.59	1.56	1.21	1.19	1.34	1.57	1.65	1.45 TA
ENGINE OBSERVED POWER	HP	1.14	8.45	292.49	240.77	121.83	8.68	1.26	
OBS BMEP	PSI	2.90	10.73	156.31	142.97	74.82	11.02	3.19	
OBS BSFC	LBM/BHP-HR	6.565	1.987	0.496	0.482	0.624	1.935	6.366	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.54863	1.96084	1.53837	0.62374	0.77378	2.05595	3.55501	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.23050	0.23194	0.00526	0.00259	0.00635	0.23680	2.82892	
HC MASS / MODE	LB	0.04248	0.35949	0.00769	0.05198	0.07738	0.10280	0.05925	0.70106
HC MASS / RATED HP	LB/HP								0.00234
HC - PERCENT OF EPA STANDARD									122.99
CO EMISSION RATE	LB/HR	3.94540	16.50876	121.06735	97.95264	84.47644	15.46234	4.40360	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.45354	1.95279	0.41392	0.40682	0.69341	1.78088	3.50420	
CO MASS / MODE	LB	0.06576	3.02661	0.60534	8.16272	8.44764	0.77312	0.07339	21.15454
CO MASS / RATED HP	LB/HP								0.07052
CO - PERCENT OF EPA STANDARD									167.89
NOX EMISSION RATE	LB/HR	0.00317	0.01121	0.95647	0.81438	0.15550	0.01140	0.00991	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00277	0.00133	0.00327	0.00338	0.00128	0.00131	0.00788	
NOX MASS / MODE	LB	0.00005	0.00205	0.00478	0.06787	0.01555	0.00057	0.00017	0.09104
NOX MASS / RATED HP	LB/HP								0.00030
NOX- PERCENT OF EPA STANDARD									20.23

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08916	0.09751	0.08259	0.08227	0.09163	0.09558	0.08010	0.09211 TA
DIFF. CALC & MEAS F/A	PERCENT	-15.92	-6.33	1.86	3.16	2.09	-8.75	-27.19	-4.64 TA
DIFF BV & CB RATE	PERCENT	0.05	0.05	0.05	0.13	0.05	0.05	-2.68	
SUM OF MOLE FRACTIONS		0.95536	1.00316	1.01626	1.01559	1.01820	0.98112	0.87047	

D-2

IO-520-D S/N 559025 TEST 3 BASELINE 22 DEG BTC RUNS 15-21 02/24/75

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.934	56.00	45.00	2.1250	54.70	300.00	520.00	3.000 5.550	0.380

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.50	16.70	144.00	116.00	76.00	16.90	8.10	
INDUCTION AIR FLOW (W)	LB/HR	75.00	163.00	1785.00	1465.00	845.00	165.00	68.00	
HYDROCARBON CONC.	PPM-C W	53000.00	21000.00	1800.00	850.00	1775.00	16750.00	56500.00	
OXIDES OF NITROGEN CONC	PPM W	25.00	37.50	305.00	300.00	110.00	35.00	25.00	
CARBON MONOXIDE CONC.	PERCENT	5.10	9.50	7.10	7.25	10.40	8.35	4.65	
CARBON DIOXIDE CONC.	PERCENT	9.75	7.65	9.65	9.10	7.85	8.30	6.25	
OXYGEN CONC.	PERCENT	5.50	1.50	0.44	0.38	0.38	1.38	6.25	
WET CORRECTION FACTOR	--	0.98706	0.89636	0.86069	0.85838	0.86510	0.91224	0.99585	
PROP. TORQUE	FT-LB	10.00	37.00	535.00	490.00	258.00	37.00	12.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MELD PRESSURE	IN HG ABS DRY	17.00	13.50	28.50	27.20	18.20	13.50	17.00	
INDUCTION AIR TEMP	DEG F	53.00	53.00	60.00	61.00	60.00	55.00	55.00	
COOLING AIR TEMP	DEG F	0.0	0.0	65.00	67.00	65.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.70	1.70	1.70	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	272.00	375.00	450.00	442.00	346.00	290.00	315.00	
EXHAUST GAS TEMP	DEG F	410.00	690.00	1420.00	1360.00	1170.00	700.00	0.0	
INDUCTION F/A RATIO (D)	LB/LB	0.11377	0.10285	0.08098	0.07948	0.09028	0.10282	0.11957	0.09657 TA
IND. F/A EQUIV. RATIO	--	1.70	1.54	1.21	1.19	1.35	1.54	1.79	1.44 TA
ENGINE OBSERVED POWER	HP	1.14	8.45	290.32	239.31	121.83	8.45	1.37	
OBS BMEP	PSI	2.90	10.73	155.15	142.10	74.82	10.73	3.48	
OBS BSFC	LBM/BHP-HR	7.440	1.575	0.496	0.485	0.624	1.999	5.909	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.21304	1.96782	1.74098	0.68465	0.82839	1.64571	2.71852	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.93715	0.23277	0.00600	0.00286	0.00680	0.19467	1.98301	
HC MASS / MODE	LB	0.03688	0.36077	0.00870	0.05705	0.08284	0.08229	0.04531	0.67384
HC MASS / RATED HP	LB/HP								0.00225
HC - PERCENT OF EPA STANDARD									118.22
CO EMISSION RATE	LB/HR	4.24340	16.10872	119.31981	101.19318	84.76643	15.10853	4.49798	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.71439	1.90547	0.41100	0.42286	0.69579	1.78716	3.28103	
CO MASS / MODE	LB	0.07072	2.95326	0.59660	8.43276	8.47664	0.75543	0.07497	21.36035
CO MASS / RATED HP	LB/HP								0.07120
CO - PERCENT OF EPA STANDARD									169.53
NOX EMISSION RATE	LB/HR	0.00346	0.01165	0.97820	0.80126	0.17023	0.01140	0.00399	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00303	0.00138	0.00337	0.00335	0.00140	0.00135	0.00291	
NOX MASS / MODE	LB	0.00006	0.00214	0.00489	0.06677	0.01702	0.00057	0.00007	0.09152
NOX MASS / RATED HP	LB/HP								0.00031
NOX- PERCENT OF EPA STANDARD									20.34

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08402	0.09686	0.08280	0.08355	0.09245	0.09141	0.08667	0.09185 TA
DIFF. CALC & MEAS F/A	PERCENT	-26.14	-5.82	2.24	5.12	2.40	-11.09	-27.52	-4.89 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.18	0.05	0.05	-0.87	
SUM OF MOLE FRACTIONS		1.06410	1.00140	1.00339	0.98437	1.01777	0.97190	0.84976	

D-3

IO-520-D S/N 559025 TEST 4 BASELINE 22 DEG BTC RUNS 22-28 03/07/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.232	57.00	65.00	2.1250	65.14	300.00	520.00	3.000 5.550	1.476

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	28.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.20	16.50	147.50	123.00	79.00	16.70	7.20	
INDUCTION AIR FLOW (W)	LB/HR	77.00	160.00	1770.00	1475.00	850.00	163.00	77.00	
HYDROCARBON CONC.	PPM-C W	58750.00	23250.00	1650.00	1000.00	1650.00	21650.00	61400.00	
OXIDES OF NITROGEN CONC	PPM W	25.00	35.00	225.00	193.70	86.25	35.00	30.00	
CARBON MONOXIDE CONC.	PERCENT	5.10	9.10	8.25	9.00	10.90	9.10	4.65	
CARBON DIOXIDE CONC.	PERCENT	7.00	7.50	9.25	8.90	7.60	7.75	6.50	
OXYGEN CONC.	PERCENT	6.00	2.12	0.50	0.50	0.50	1.87	6.87	
WET CORRECTION FACTOR	--	0.94751	0.89815	0.85101	0.84559	0.86370	0.89471	0.91450	
PROP. TORQUE	FT-LB	13.00	37.00	530.00	493.00	255.00	37.00	13.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	17.00	13.50	28.80	28.10	18.60	13.60	17.00	
INDUCTION AIR TEMP	DEG F	56.00	59.00	71.00	72.00	69.00	66.00	63.00	
COOLING AIR TEMP	DEG F	0.0	0.0	76.00	78.00	79.00	72.00	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.10	1.10	1.10	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	365.00	413.00	460.00	453.00	371.00	348.00	384.00	
EXHAUST GAS TEMP	DEG F	0.0	680.00	1415.00	1335.00	1170.00	680.00	380.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10809	0.10467	0.08458	0.08464	0.09433	0.10399	0.09491	0.09820 TA
IND. F/A EQUIV. RATIO	--	1.62	1.57	1.27	1.27	1.41	1.56	1.42	1.47 TA
ENGINE OBSERVED POWER	HP	1.49	8.45	287.60	240.77	120.41	8.45	1.49	
OBS BMEP	PSI	3.77	10.73	153.70	142.97	73.95	10.73	3.77	
OBS BSFC	LBM/BHP-HR	5.521	1.952	0.513	0.511	0.656	1.975	4.848	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.72386	2.18233	1.58463	0.79148	0.79163	2.05601	2.65305	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.83407	0.25814	0.00551	0.00329	0.00657	0.24320	1.78638	
HC MASS / MODE	LB	0.04540	0.40009	0.00792	0.06596	0.07916	0.10280	0.04422	0.74555
HC MASS / RATED HP	LB/HP								0.00249
HC - PERCENT OF EPA STANDARD									130.80
CO EMISSION RATE	LB/HR	4.52290	15.48732	136.11877	121.59900	91.18335	15.60904	3.70938	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.04542	1.83197	0.47328	0.50503	0.75727	1.84637	2.49765	
CO MASS / MODE	LB	0.07538	2.83934	0.68059	10.13325	9.11833	0.78045	0.06182	23.68915
CO MASS / RATED HP	LB/HP								0.07896
CO - PERCENT OF EPA STANDARD									188.01
NOX EMISSION RATE	LB/HR	0.00384	0.01089	0.71653	0.50837	0.13722	0.01102	0.00430	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00259	0.00129	0.00249	0.00211	0.00114	0.00130	0.00289	
NOX MASS / MODE	LB	0.00006	0.00200	0.00358	0.04236	0.01372	0.00055	0.00007	0.06235
NOX MASS / RATED HP	LB/HP								0.00021
NOX - PERCENT OF EPA STANDARD									13.86

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08987	0.09492	0.08519	0.08678	0.09334	0.09461	0.08883	0.09253 TA
DIFF. CALC & MEAS F/A	PERCENT	-16.85	-5.32	0.72	2.53	-1.05	-9.02	-6.41	-5.77 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		0.95920	0.99256	1.02055	1.03313	1.01551	0.95746	0.98686	

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IO-520-D S/N 559025 TEST 5A LEAN OUT RUNS 29,33,37,38,41 03/12/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.927	75.50	72.00	2.1250	75.50	300.00	520.00	3.000	5.550	1.580

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	33.	37.	38.	41.	33.	29.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	15.00	143.00	115.00	70.00	15.00	7.00	
INDUCTION AIR FLOW (W)	LB/HR	85.00	173.00	1760.00	1425.00	825.00	173.00	85.00	
HYDROCARBON CONC.	PPM-C W	37500.00	18500.00	2000.00	1000.00	1350.00	18500.00	37500.00	
OXIDES OF NITROGEN CONC	PPM W	27.50	37.50	275.00	350.00	132.00	37.50	27.50	
CARBON MONOXIDE CONC.	PERCENT	3.50	7.90	7.40	6.50	7.90	7.90	3.50	
CARBON DIOXIDE CONC.	PERCENT	7.50	8.45	9.75	10.25	8.90	8.45	7.90	
OXYGEN CONC.	PERCENT	5.75	1.50	0.13	0.13	0.75	1.50	5.75	
WET CORRECTION FACTOR	--	0.91360	0.84813	0.84326	0.85170	0.86560	0.84813	0.91360	
FRCP. TORQUE	FT-LB	10.00	40.00	536.00	492.00	250.00	40.00	10.00	
FRCP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.50	13.50	28.75	27.70	17.80	13.50	16.50	
INDUCTION AIR TEMP	DEG F	88.00	83.00	83.00	88.00	87.00	83.00	88.00	
COOLING AIR TEMP	DEG F	86.00	75.00	88.00	89.00	87.00	75.00	86.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	2.00	2.00	2.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	315.00	395.00	458.00	436.00	352.00	395.00	315.00	
EXHAUST GAS TEMP	DEG F	400.00	700.00	1425.00	1365.00	1220.00	700.00	400.00	
INDUCTION F/A RATIO (O)	LB/LB	0.08368	0.08810	0.08255	0.08200	0.08621	0.08810	0.08368	0.08618 TA
*IND. F/A EQUIV. RATIO	--	1.25	1.32	1.24	1.23	1.29	1.32	1.25	1.29 TA
ENGINE OBSERVED POWER	HP	1.14	9.14	290.86	240.29	118.05	9.14	1.14	
CBS BMEP	PSI	2.90	11.60	155.44	142.68	72.50	11.60	2.90	
CBS BSFC	LBM/BHP-HR	6.127	1.641	0.492	0.479	0.593	1.641	6.127	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.81685	1.73103	1.91241	0.78482	0.63125	1.73103	1.81685	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.59035	0.18940	0.00658	0.00327	0.00535	0.18940	1.59035	
HC MASS / MODE	LB	0.03028	0.31735	0.00956	0.06540	0.06312	0.08655	0.03028	0.60256
HC MASS / RATED HP	LB/HP								0.00201
HC - PERCENT OF EPA STANDARD									105.71
CO EMISSION RATE	LB/HR	3.12752	12.65635	120.45752	87.71181	64.55026	12.65635	3.12752	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.73762	1.38482	0.41414	0.36503	0.54680	1.38482	2.73762	
CO MASS / MODE	LB	0.05213	2.32033	0.60229	7.30931	6.45502	0.63282	0.05213	17.42401
CO MASS / RATED HP	LB/HP								0.05808
CO - PERCENT OF EPA STANDARD									138.29
NOX EMISSION RATE	LB/HR	0.00442	0.01164	0.87195	0.91085	0.20467	0.01164	0.00442	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00387	0.00127	0.00300	0.00379	0.00173	0.00127	0.00387	
NOX MASS / MODE	LB	0.00007	0.00213	0.00436	0.07590	0.02047	0.00058	0.00007	0.10359
NOX MASS / RATED HP	LB/HP								0.00035
NOX- PERCENT OF EPA STANDARD									23.02

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.07649	0.09150	0.08460	0.08169	0.08387	0.09150	0.07649	0.08685 TA
DIFF. CALC & MEAS F/A	PERCENT	-8.59	3.87	2.47	-0.37	-2.72	3.87	-8.59	0.78 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		0.95992	1.01871	1.00847	0.99443	0.98586	1.01871	0.95992	

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D-6

IO-520-D S/N 559025 TEST 5B LEAN OUT RUNS 30,34,37,39,42 03/12/75

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.927	75.50	72.00	2.1250	75.50	300.00	520.00	3.000 5.550	1.580

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	30.	34.	37.	39.	42.	34.	30.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.00	14.00	143.00	110.00	65.00	14.00	6.00	
INDUCTION AIR FLOW (W)	LB/HR	85.00	175.00	1760.00	1425.00	825.00	175.00	85.00	
HYDROCARBON CONC.	PPM-C W	35000.00	12000.00	2000.00	850.00	1125.00	12000.00	35000.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	42.00	275.00	540.00	275.00	42.00	30.00	
CARBON MONOXIDE CONC.	PERCENT	3.20	7.70	7.40	5.30	5.75	7.70	3.20	
CARBON DIOXIDE CONC.	PERCENT	8.15	9.25	9.75	10.90	10.25	9.25	8.15	
OXYGEN CONC.	PERCENT	6.00	0.63	0.13	0.13	0.63	0.63	6.00	
WET CORRECTION FACTOR	--	0.86888	0.83881	0.84326	0.84926	0.86016	0.83881	0.86888	
PROP. TORQUE	FT-LB	11.00	42.00	536.00	494.00	254.00	42.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.00	12.90	28.75	27.70	17.80	12.90	16.00	
INDUCTION AIR TEMP	DEG F	75.00	76.00	88.00	87.00	83.00	76.00	75.00	
COOLING AIR TEMP	DEG F	88.00	88.00	88.00	88.00	84.00	88.00	88.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	2.00	2.00	2.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	319.00	415.00	458.00	435.00	358.00	415.00	319.00	
EXHAUST GAS TEMP	DEG F	400.00	715.00	1425.00	1390.00	1260.00	715.00	400.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07172	0.08128	0.08255	0.07843	0.08005	0.08128	0.07172	0.07980 TA
IND. F/A EQUIV. RATIO	--	1.07	1.22	1.24	1.17	1.20	1.22	1.07	1.19 TA
ENGINE OBSERVED POWER	HP	1.26	9.60	290.86	241.26	119.94	9.60	1.26	
CBS BMEP	PSI	3.19	12.18	155.44	143.26	73.66	12.18	3.19	
CBS BSFC	LBM/BHP-HR	4.775	1.459	0.492	0.456	0.542	1.459	4.775	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.54086	1.06830	1.91241	0.66220	0.51670	1.06830	1.54086	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.22615	0.11132	0.00658	0.00274	0.00431	0.11132	1.22615	
HC MASS / MODE	LB	0.02568	0.19586	0.00956	0.05518	0.05167	0.05342	0.02568	0.41705
HC MASS / RATED HP	LB/HP								0.00139
HC - PERCENT OF EPA STANDARD									73.17
CO EMISSION RATE	LB/HR	2.47111	11.60792	120.45752	70.79030	45.85860	11.60792	2.47111	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.96641	1.20962	0.41414	0.29342	0.38235	1.20962	1.96641	
CO MASS / MODE	LB	0.04119	2.12812	0.60229	5.89919	4.58586	0.58040	0.04119	13.87822
CO MASS / RATED HP	LB/HP								0.04626
CO - PERCENT OF EPA STANDARD									110.14
NOX EMISSION RATE	LB/HR	0.00438	0.01240	0.87195	1.39499	0.41882	0.01240	0.00438	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00349	0.00129	0.00300	0.00578	0.00349	0.00129	0.00349	
NOX MASS / MODE	LB	0.00007	0.00227	0.00436	0.11625	0.04188	0.00062	0.00007	0.16553
NOX MASS / RATED HP	LB/HP								0.00055
NOX- PERCENT OF EPA STANDARD									36.78

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.07445	0.08970	0.08460	0.07868	0.07843	0.08970	0.07445	0.08403 TA
DIFF. CALC & MEAS F/A	PERCENT	3.80	10.35	2.47	0.31	-2.02	10.35	3.80	5.30 TA
DIFF EV & CB RATE	PERCENT	0.05	1.19	0.05	0.05	0.05	1.19	0.05	
SUM OF MOLE FRACTIONS		1.01476	1.06036	1.00847	0.98914	0.98090	1.06036	1.01476	

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IO-520-D S/N 559025 TEST 5C LEAN OUT RUNS 31,35,37,40,43 03/12/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.927	75.50	72.00	2.1250	75.50	300.00	520.00	3.000	5.550	1.580

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	31.	35.	37.	40.	43.	35.	31.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	5.00	13.00	143.00	105.00	60.00	13.00	5.00	
INDUCTION AIR FLOW (W)	LB/HR	80.00	170.00	1760.00	1430.00	820.00	170.00	80.00	
HYDROCARBON CONC.	PPM-C W	33500.00	12000.00	2000.00	750.00	850.00	12000.00	33500.00	
OXIDES OF NITROGEN CONC	PPM W	31.25	37.50	275.00	830.00	690.00	37.50	31.25	
CARBON MONOXIDE CONC.	PERCENT	1.70	6.50	7.40	3.85	3.00	6.50	1.70	
CARBON DIOXIDE CONC.	PERCENT	7.00	9.75	9.75	11.50	11.85	9.75	7.00	
OXYGEN CONC.	PERCENT	9.25	1.00	0.13	0.13	0.63	1.00	9.25	
WET CORRECTION FACTOR	--	0.92651	0.83881	0.84326	0.84910	0.86457	0.83881	0.92651	
PROP. TORQUE	FT-LB	12.00	39.00	536.00	490.00	257.00	39.00	12.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
FELD PRESSURE IN HG ABS DRY		17.50	13.50	26.75	27.70	17.80	13.50	17.50	
INDUCTION AIR TEMP	DEG F	0.0	76.00	88.00	87.00	83.00	76.00	0.0	
COOLING AIR TEMP	DEG F	0.0	76.00	88.00	88.00	88.00	76.00	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	2.00	2.00	2.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	0.0	421.00	458.00	450.00	370.00	421.00	0.0	
EXHAUST GAS TEMP	DEG F	360.00	705.00	1425.00	1440.00	1315.00	705.00	360.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06350	0.07770	0.08255	0.07461	0.07435	0.07770	0.06350	0.07541 TA
IND. F/A EQUIV. RATIO	—	0.95	1.16	1.24	1.12	1.11	1.16	0.95	1.13 TA
ENGINE OBSERVED POWER	HP	1.37	8.91	290.86	239.31	121.36	8.91	1.37	
CBS BMEP	PSI	3.48	11.31	155.44	142.10	74.53	11.31	3.48	
CBS BSFC	LBM/BHP-HR	3.647	1.459	0.492	0.439	0.494	1.459	3.647	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.43917	1.03127	1.91241	0.58898	0.38689	1.03127	1.43917	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.04980	0.11573	0.00658	0.00246	0.00319	0.11573	1.04980	
HC MASS / MODE	LB	0.02399	0.18907	0.00956	0.04908	0.03869	0.05156	0.02399	0.38593
HC MASS / RATED HP	LB/HP								0.00129
HC - PERCENT OF EPA STANDARD									67.71
CO EMISSION RATE	LB/HR	1.36601	9.45922	120.45752	51.82570	23.83282	9.45922	1.36601	
BRAKE SPECIFIC CO	LBM/BHP-HR	0.99643	1.06153	0.41414	0.21656	0.19639	1.06153	0.99643	
CO MASS / MODE	LB	0.02277	1.73419	0.60229	4.31881	2.38328	0.47296	0.02277	9.55706
CO MASS / RATED HP	LB/HP								0.03186
CO - PERCENT OF EPA STANDARD									75.85
NOX EMISSION RATE	LB/HR	0.00445	0.01069	0.87195	2.16135	1.04142	0.01069	0.00445	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00325	0.00120	0.00300	0.00903	0.00858	0.00120	0.00325	
NOX MASS / MODE	LB	0.00007	0.00196	0.00436	0.18011	0.10414	0.00053	0.00007	0.29126
NOX MASS / RATED HP	LB/HP								0.00097
NOX- PERCENT OF EPA STANDARD									64.72

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.05893	0.08526	0.08460	0.07536	0.07181	0.08526	0.05893	0.07856 TA
DIFF. CALC & MEAS F/A	PERCENT	-7.20	9.73	2.47	1.02	-3.41	9.73	-7.20	4.17 TA
DIFF EV & CB RATE	PERCENT	0.05	1.07	0.05	0.05	0.05	1.07	0.05	
SUM OF MOLE FRACTIONS		0.98410	1.05616	1.00847	0.97115	0.96399	1.05616	0.98410	

IO-520-D S/N 559025 TEST 5D LEAN OUT RUNS 32,36,37,40,44 03/12/75

PBARC	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.927	75.50	72.00	2.1250	75.50	300.00	520.00	3.000 5.550	1.580

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	32.	36.	37.	40.	44.	36.	32.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	5.50	12.00	143.00	105.00	55.00	12.00	5.50	
INDUCTION AIR FLOW (W)	LB/HR	80.00	170.00	1760.00	1430.00	815.00	170.00	80.00	
HYDROCARBON CONC.	PPM-C W	33000.00	7000.00	2000.00	750.00	300.00	7000.00	33000.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	47.50	275.00	830.00	1150.00	47.50	30.00	
CARBON MONOXIDE CONC.	PERCENT	2.40	5.30	7.40	3.85	1.10	5.30	2.40	
CARBON DIOXIDE CONC.	PERCENT	8.15	10.65	9.75	11.50	13.25	10.65	8.15	
OXYGEN CONC.	PERCENT	6.63	0.63	0.13	0.13	0.75	0.63	6.63	
WET CORRECTION FACTOR	--	0.88972	0.83881	0.84326	0.84910	0.85940	0.83881	0.88972	
PROP. TORQUE	FT-LB	15.00	40.00	536.00	490.00	249.00	40.00	15.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.00	13.00	28.75	27.70	17.80	13.00	16.00	
INDUCTION AIR TEMP	DEG F	74.00	76.00	88.00	87.00	83.00	76.00	74.00	
COOLING AIR TEMP	DEG F	79.00	76.00	88.00	88.00	88.00	76.00	79.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	2.00	2.00	2.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	229.00	420.00	458.00	450.00	362.00	420.00	229.00	
EXHAUST GAS TEMP	DEG F	355.00	730.00	1425.00	1440.00	1375.00	730.00	355.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06985	0.07172	0.08255	0.07461	0.06857	0.07172	0.06985	0.07154 TA
IND. F/A EQUIV. RATIO	--	1.05	1.07	1.24	1.12	1.03	1.07	1.05	1.07 TA
ENGINE OBSERVED POWER	HP	1.71	9.14	290.86	239.31	117.58	9.14	1.71	
OBS BMEP	PSI	4.35	11.60	155.44	142.10	72.21	11.60	4.35	
OBS BSFC	LBM/BHP-HR	3.210	1.313	0.492	0.439	0.468	1.313	3.210	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.40262	0.58494	1.91241	0.58898	0.13085	0.58494	1.40262	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.81851	0.06400	0.00658	0.00246	0.00111	0.06400	0.81851	
HC MASS / MODE	LB	0.02338	0.10724	0.00956	0.04908	0.01309	0.02925	0.02338	0.25497
HC MASS / RATED HP	LB/HP								0.00085
HC - PERCENT OF EPA STANDARD									44.73
CO EMISSION RATE	LB/HR	1.83223	7.49969	120.45752	51.82570	8.32422	7.49969	1.83223	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.06921	0.82059	0.41414	0.21656	0.07080	0.82059	1.06921	
CO MASS / MODE	LB	0.03054	1.37494	0.60229	4.31881	0.83242	0.37498	0.03054	7.56452
CO MASS / RATED HP	LB/HP								0.02522
CO - PERCENT OF EPA STANDARD									60.04
NOX EMISSION RATE	LB/HR	0.00423	0.01316	0.87195	2.16135	1.66331	0.01316	0.00423	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00247	0.00144	0.00300	0.00903	0.01415	0.00144	0.00247	
NOX MASS / MODE	LB	0.00007	0.00241	0.00436	0.18011	0.16633	0.00066	0.00007	0.35401
NOX MASS / RATED HP	LB/HP								0.00118
NOX- PERCENT OF EPA STANDARD									78.67
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.06912	0.08059	0.08460	0.07536	0.06702	0.08059	0.06912	0.07585 TA
DIFF. CALC & MEAS F/A	PERCENT	-1.05	12.36	2.47	1.02	-2.26	12.36	-1.05	6.03 TA
DIFF EV & CB RATE	PERCENT	0.05	1.76	0.05	0.05	0.05	1.76	0.05	
SUM OF MOLE FRACTIONS		0.99215	1.06711	1.00847	0.97115	0.98031	1.06711	0.99215	

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IO-520-D S/N 559025 TEST 6 BASELINE 20 DEG BTC RUNS 45-50 03/14/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.128	58.50	48.00	2.1250	63.00	300.00	520.00	3.000 5.550	0.466

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	45.	46.	0.	47.	48.	49.	50.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.10	17.20	143.00	121.00	80.00	16.80	8.10	
INDUCTION AIR FLOW (W)	LB/HR	75.00	180.00	1760.00	1465.00	860.00	175.00	70.00	
HYDROCARBON CONC.	PPM-C W	50000.00	18000.00	1650.00	950.00	1700.00	18000.00	50000.00	
OXIDES OF NITROGEN CONC	PPM W	27.50	42.50	225.00	240.00	93.00	42.50	28.75	
CARBON MONOXIDE CONC.	PERCENT	5.15	9.46	8.25	7.70	10.50	9.46	5.15	
CARBON DIOXIDE CONC.	PERCENT	6.80	7.75	9.25	9.00	7.50	7.70	7.25	
OXYGEN CONC.	PERCENT	6.00	1.50	0.50	1.30	0.75	1.85	5.25	
WET CORRECTION FACTOR	--	0.98050	0.87845	0.85700	0.87811	0.88064	0.88574	0.98884	
FRCP. TORQUE	FT-LB	10.00	40.00	536.00	492.00	255.00	40.00	10.00	
FRCP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	17.00	13.70	0.0	27.70	18.70	14.00	17.50	
INDUCTION AIR TEMP	DEG F	59.00	59.00	67.00	67.00	66.00	63.00	61.00	
COOLING AIR TEMP	DEG F	0.0	0.0	75.00	75.00	79.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	1.30	1.30	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	446.00	398.00	0.0	448.00	365.00	384.00	392.00	
EXHAUST GAS TEMP	DEG F	360.00	700.00	0.0	1317.00	1195.00	705.00	420.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10851	0.09600	0.08163	0.08298	0.09346	0.09645	0.11626	0.09415 TA
IND. F/A EQUIV. RATIO	--	1.62	1.44	1.22	1.24	1.40	1.44	1.74	1.41 TA
ENGINE OBSERVED POWER	HP	1.14	9.14	290.86	240.29	120.41	9.14	1.14	
CBS BMEP	PSI	2.90	11.60	155.44	142.68	73.95	11.60	2.90	
CBS BSFC	LBM/BHP-HR	7.090	1.882	0.492	0.504	0.664	1.838	7.090	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.37523	1.79415	1.52566	0.76357	0.83223	1.74405	2.30028	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.07911	0.19631	0.00525	0.00318	0.00691	0.19083	2.01351	
HC MASS / MODE	LB	0.03959	0.32693	0.00763	0.06363	0.08322	0.08720	0.03834	0.64854
HC MASS / RATED HP	LB/HP								0.00216
HC - PERCENT OF EPA STANDARD									113.78
CO EMISSION RATE	LB/HR	4.84260	16.72165	131.97610	109.71106	91.38382	16.38568	4.72969	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.23889	1.82563	0.45374	0.45659	0.75893	1.79330	4.14006	
CO MASS / MODE	LB	0.08071	3.06564	0.65988	9.14259	9.13838	0.81948	0.07883	22.98549
CO MASS / RATED HP	LB/HP								0.07662
CO - PERCENT OF EPA STANDARD									182.42
NOX EMISSION RATE	LB/HR	0.00433	0.01405	0.68986	0.63965	0.15097	0.01365	0.00439	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00379	0.00154	0.00237	0.00266	0.00125	0.00149	0.00384	
NOX MASS / MODE	LB	0.00007	0.00258	0.00345	0.05330	0.01510	0.00068	0.00007	0.07525
NOX MASS / RATED HP	LB/HP								0.00025
NOX- PERCENT OF EPA STANDARD									16.72
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08485	0.09508	0.08519	0.08095	0.09171	0.09354	0.08706	0.09080 TA
DIFF. CALC & MEAS F/A	PERCENT	-21.80	-0.96	4.36	-2.45	-1.87	-3.02	-25.11	-3.55 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.39	0.05	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		0.92451	1.02030	1.03842	1.00765	1.00252	1.02529	0.90705	

IC-520-D S/N 559025 TEST 7 BASELINE 18 DEG BTC RUNS 51-54 03/27/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C	H	PERCENT
30.125	67.50	60.00	2.1250	67.50	300.00	520.00	3.000	5.550	0.920

	UNITS	MODE 1	MODE 2	MODE 4	MODE 5	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	51.	52.	53.	54.			
TIME IN MODE	MINUTES	1.00	11.00	5.00	6.00			
FUEL FLOW	LB/HR	8.57	16.90	123.00	79.50			
INDUCTION AIR FLOW (W)	LB/HR	78.30	180.00	1480.00	870.00			
HYDROCARBON CONC.	PPM-C W	44000.00	18250.00	850.00	1575.00			
OXIDES OF NITROGEN CONC	PPM W	25.25	40.00	220.00	87.50			
CARBON MONOXIDE CONC.	PERCENT	4.30	8.65	7.80	10.35			
CARBON DIOXIDE CONC.	PERCENT	7.20	7.55	8.75	7.40			
OXYGEN CONC.	PERCENT	6.00	1.88	1.25	1.00			
WET CORRECTION FACTOR	--	0.98950	0.88107	0.87528	0.87678			
FRCP. TORQUE	FT-LB	10.00	40.00	495.00	255.00			
FRCP. SPEED	RPM	600.00	1200.00	2565.00	2480.00			
MFLD PRESSURE	IN HG ABS DRY	16.50	13.50	27.90	18.60			
INDUCTION AIR TEMP	DEG F	8.00	68.00	76.00	75.00			
COOLING AIR TEMP	DEG F	70.06	70.00	84.00	74.00			
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.40	1.40			
MAX CYL HEAD TEMP	DEG F	335.00	394.00	441.00	359.00			
EXHAUST GAS TEMP	DEG F	400.00	720.00	1375.00	1220.00			
INDUCTION F/A RATIO (D)	LB/LB	0.11041	0.05476	0.08388	0.09223			
IND. F/A EQUIV. RATIO	--	1.65	1.42	1.25	1.38			
ENGINE OBSERVED POWER	HP	1.14	5.14	241.75	120.41			
OBS BMEP	PSI	1.45	5.80	71.77	36.97			
OBS BSFC	LBM/BHP-HR	7.502	1.849	0.509	0.660			
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	2.34292	1.92383	0.70347	0.78090			
BRAKE SPECIFIC HC	LBM/BHP-HR	2.05083	0.21050	0.00291	0.00649			
HC MASS / MODE	LB	0.03905	0.35270	0.05862	0.07809			
CO EMISSION RATE	LB/HR	4.57376	15.78632	114.06593	90.83040			
BRAKE SPECIFIC CO	LBM/BHP-HR	4.00357	1.72729	0.47183	0.75433			
CO MASS / MODE	LB	0.07623	2.89416	9.50549	9.08304			
NOX EMISSION RATE	LB/HR	0.00446	0.01361	0.60375	0.14386			
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00390	0.00149	0.00250	0.00119			
NOX MASS / MODE	LB	0.00007	0.00250	0.05031	0.01439			
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.07946	0.05283	0.08160	0.09046			
DIFF. CALC & MEAS F/A	PERCENT	-28.07	-2.04	-2.72	-1.92			
DIFF EV & CB RATE	PERCENT	-0.75	0.05	0.05	0.05			
SUM OF MOLE FRACTIONS		0.87667	0.95009	0.95353	1.00102			

AD-A069 012 TELEDYNE CONTINENTAL MOTORS MOBILE AL AIRCRAFT PRODU--ETC F/G 21/7
EXHAUST EMISSIONS CHARACTERISTICS OF FIVE AIRCRAFT PISTON ENGIN--ETC(U)
MAR 79 K J STUCKAS DOT-FA74NA-1091

UNCLASSIFIED FAA/RD-78-88 NL

3 OF 4
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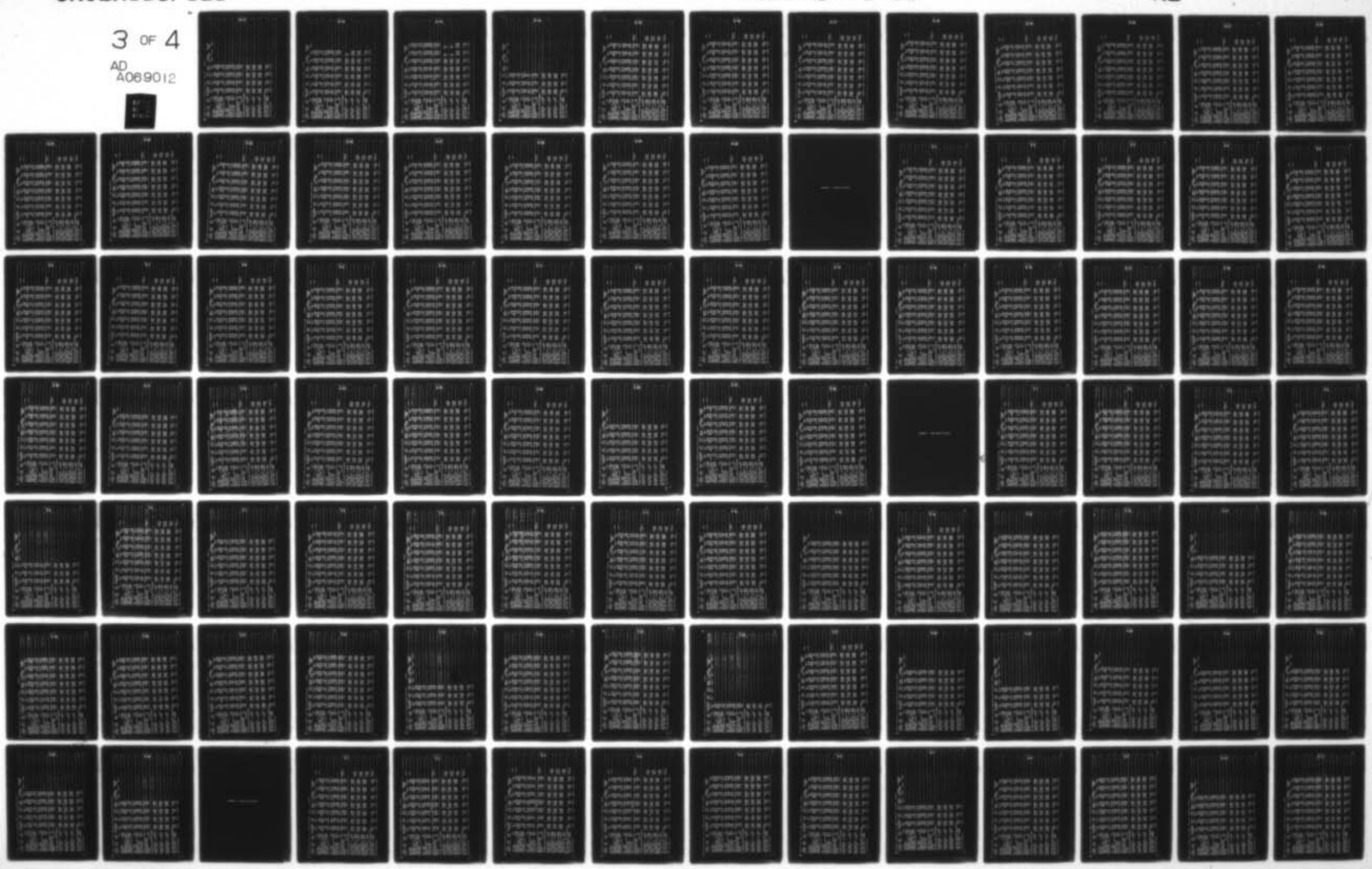

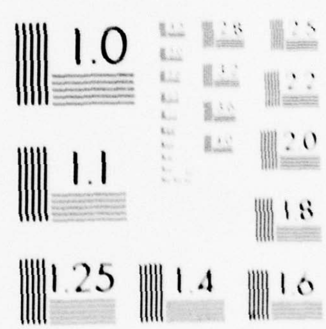

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

IO-520-D S/N 559025 TEST 8 BASELINE 14 DEG BTC RUNS 55-58 03/27/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.125	67.50	60.00	2.1250	67.00	300.00	520.00	3.000	5.550	0.920

	UNITS	MODE 1	MODE 2	MODE 4	MODE 5	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	55.	56.	57.	58.			
TIME IN MODE	MINUTES	1.00	11.00	5.00	6.00			
FUEL FLOW	LB/HR	7.20	17.20	130.00	83.00			
INDUCTION AIR FLOW (W)	LB/HR	77.50	187.50	1530.00	912.00			
HYDROCARBON CONC.	PPM-C W	38500.00	15250.00	1125.00	1450.00			
OXIDES OF NITROGEN CONC	PPM W	28.70	41.25	175.00	92.50			
CARBON MONOXIDE CONC.	PERCENT	4.20	9.40	8.60	10.35			
CARBON DIOXIDE CONC.	PERCENT	7.50	8.15	8.85	7.95			
OXYGEN CONC.	PERCENT	5.25	1.13	0.50	0.50			
WET CORRECTION FACTOR	--	0.94264	0.85591	0.86102	0.86684			
FRCP. TORQUE	FT-LB	10.00	40.00	492.00	255.00			
FRCP. SPEED	RPM	600.00	1200.00	2565.00	2480.00			
FELD PRESSURE	IN HG ABS DRY	16.80	14.00	28.50	19.30			
INDUCTION AIR TEMP	DEG F	74.00	70.00	76.00	75.00			
COOLING AIR TEMP	DEG F	74.00	76.00	82.00	82.00			
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.30	1.30			
MAX CYL HEAD TEMP	DEG F	303.00	389.00	436.00	365.00			
EXHAUST GAS TEMP	DEG F	450.00	770.00	1410.00	1270.00			
INDUCTION F/A RATIO (D)	LB/LB	0.09377	0.09259	0.08576	0.09185			
IND. F/A EQUIV. RATIO	--	1.40	1.39	1.28	1.37			
ENGINE OBSERVED POWER	HP	1.16	9.16	260.29	120.41			
OBS BMEP	PSI	1.45	5.80	71.34	36.97			
OBS BSFC	LBM/BHP-HR	6.302	1.882	0.541	0.689			
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.78140	1.54763	0.94723	0.73708			
BRAKE SPECIFIC HC	LBM/BHP-HR	1.55932	0.16934	0.00394	0.00612			
HC MASS / MODE	LB	0.02969	0.28373	0.07894	0.07371			
CO EMISSION RATE	LB/HR	3.69814	16.56026	125.86415	92.06847			
BRAKE SPECIFIC CO	LBM/BHP-HR	3.23711	1.81197	0.52381	0.76462			
CO MASS / MODE	LB	0.06164	3.03605	10.48868	9.20684			
NOX EMISSION RATE	LB/HR	0.00440	0.01388	0.48859	0.15592			
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00385	0.00152	0.00203	0.00129			
NOX MASS / MODE	LB	0.00007	0.00254	0.04072	0.01559			
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.07963	0.09436	0.08618	0.09138			
DIFF. CALC & MEAS F/A	PERCENT	-15.07	1.91	0.49	-0.52			
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05			
SUM OF MOLE FRACTIONS		0.94288	1.03411	1.00915	1.01778			

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IO-520-D S/N 555025 TEST 9 LEAN OUT 10 DEG BTC RUNS 59,63-67 03/27/75

PBARC IN HG ABS	TCRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.957	71.00	60.00	2.1250	71.00	300.00	520.00	3.000 5.550	0.843

	UNITS	MODE 1	MODE 2	MODE 1	MODE 2	MODE 5	MODE 5	MODE 0
RUN NUMBER	--	59.	64.	63.	65.	66.	67.	
TIME IN MODE	MINUTES	1.00	11.00	1.00	11.00	6.00	6.00	
FUEL FLOW	LB/HR	7.70	14.20	5.60	12.80	67.00	63.00	
INDUCTION AIR FLOW (W)	LB/HR	95.00	198.00	90.00	203.00	950.00	1030.00	
HYDROCARBON CONC.	PPM-C W	40000.00	3500.00	30000.00	4000.00	650.00	0.0	
OXIDES OF NITROGEN CONC	PPM W	35.00	57.50	37.50	65.00	625.00	1250.00	
CARBON MONOXIDE CONC.	PERCENT	3.90	4.65	2.73	2.32	3.10	0.25	
CARBON DIOXIDE CONC.	PERCENT	8.00	11.00	8.30	11.50	12.20	13.65	
OXYGEN CONC.	PERCENT	5.50	0.75	6.25	2.00	0.50	1.25	
WET CORRECTION FACTOR	--	0.89784	0.85090	0.85355	0.85090	0.85380	0.85154	
FRCP. TORQUE	FT-LB	10.00	40.00	10.00	15.00	255.00	255.00	
FRCP. SPEED	RPM	600.00	1200.00	600.00	1200.00	2480.00	2480.00	
MFLD PRESSURE	IN HG ABS DRY	17.50	14.50	17.50	15.00	19.10	21.50	
INDUCTION AIR TEMP	DEG F	69.00	73.00	72.00	74.00	79.00	80.00	
COOLING AIR TEMP	DEG F	0.0	0.0	0.0	0.0	81.00	83.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	1.90	1.90	
MAX CYL HEAD TEMP	DEG F	330.00	408.00	320.00	418.00	374.00	355.00	
EXHAUST GAS TEMP	DEG F	500.00	840.00	470.00	875.00	1405.00	1560.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08174	0.07233	0.06275	0.06359	0.07113	0.06168	
IND. F/A EQUIV. RATIO	--	1.22	1.08	0.94	0.95	1.06	0.92	
ENGINE OBSERVED POWER	HP	1.14	5.14	1.16	3.43	120.41	120.41	
OBS BMEP	PSI	2.90	11.60	2.90	4.35	73.95	73.95	
OBS BSFC	LBM/BHP-HR	6.740	1.554	4.902	3.735	0.556	0.523	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 1	MODE 2	MODE 5	MODE 5
HC EMISSION RATE	LB/HR	2.05639	0.39613	1.32674	0.41283	0.32523	0.0
BRAKE SPECIFIC HC	LBM/BHP-HR	1.80003	0.04334	1.16134	0.12045	0.00270	0.0
HC MASS / MODE	LB	0.03427	0.07262	0.02211	0.07568	0.03252	0.0
CO EMISSION RATE	LB/HR	3.63410	8.11308	2.08037	4.11300	26.73528	2.24265
BRAKE SPECIFIC CO	LBM/BHP-HR	3.18105	0.88771	1.82101	1.20008	0.22203	0.01862
CO MASS / MODE	LB	0.06057	1.48740	0.03467	0.75405	2.67353	0.22426
NOX EMISSION RATE	LB/HR	0.00597	0.01937	0.00550	0.02224	1.03697	2.16296
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00522	0.00212	0.00481	0.00649	0.00861	0.01796
NOX MASS / MODE	LB	0.00010	0.00355	0.00009	0.00408	0.10370	0.21630

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 1	MODE 2	MODE 5	MODE 5
CAL. FUEL AIR RATIO	LB/LB	0.07983	0.07681	0.07008	0.06780	0.07219	0.06368
DIFF. CALC & MEAS F/A	PERCENT	-2.34	6.19	11.69	6.61	1.50	3.23
DIFF EM & CB RATE	PERCENT	0.05	0.71	0.05	0.36	0.05	0.05
SUM OF MOLE FRACTIONS		0.99413	1.02717	1.03866	1.01245	0.99922	1.00900

IO-520-D S/N 559025 TEST 10 LEAN OUT 5 DEG BTC RUNS 69,70,73,74-78 03/27/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.104	68.00	57.00	2.1250	68.00	300.00	520.00	3.000	5.550	0.731

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 5	MODE 5	MODE 5
RUN NUMBER	--	69.	70.	73.	74.	76.	77.	78.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	6.00	6.00	6.00
FUEL FLOW	LB/HR	7.00	5.00	16.40	15.50	73.00	68.00	68.00
INDUCTION AIR FLOW (W)	LB/HR	95.00	120.00	225.00	240.00	1030.00	1120.00	1200.00
HYDROCARBON CONC.	PPM-C W	27500.00	25000.00	2500.00	1000.00	550.00	0.0	0.0
OXIDES OF NITROGEN CONC PPM W		37.50	33.70	60.00	62.50	375.00	1062.50	825.00
CARBON MONOXIDE CONC.	PERCENT	2.95	5.15	5.15	2.32	4.00	0.0	0.0
CARBON DIOXIDE CONC.	PERCENT	8.75	8.55	10.75	12.40	11.50	13.65	12.70
OXYGEN CONC.	PERCENT	5.25	3.00	0.50	0.63	0.38	1.13	2.50
WET CORRECTION FACTOR	--	0.90200	0.85271	0.85271	0.85271	0.85271	0.85271	0.85950
FRCP. TORQUE	FT-LB	10.00	12.00	39.00	36.00	255.00	255.00	255.00
FRCP. SPEED	RPM	600.00	700.00	1200.00	1200.00	2480.00	2480.00	2480.00
MFLD PRESSURE	IN HG ABS DRY	18.00	17.50	14.70	15.70	21.50	23.50	25.00
INDUCTION AIR TEMP	DEG F	63.00	68.00	70.00	72.00	79.00	79.00	80.00
COOLING AIR TEMP	DEG F	0.0	0.0	0.0	0.0	85.00	85.00	86.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.60	0.70	0.70
MAX CYL HEAD TEMP	DEG F	395.00	308.00	355.00	338.00	388.00	398.00	386.00
EXHAUST GAS TEMP	DEG F	620.00	620.00	1015.00	0.0	1515.00	1640.00	1635.00
INDUCTION F/A RATIO (D)	LB/LB	0.07423	0.07555	0.07343	0.06506	0.07140	0.06116	0.05708
IND. F/A EQUIV. RATIO	--	1.11	1.13	1.10	0.97	1.07	0.92	0.85
ENGINE OBSERVED POWER	HP	1.14	1.60	8.91	8.23	120.41	120.41	120.41
OBS BMEP	PSI	2.90	3.48	11.31	10.44	73.95	73.95	73.95
OBS BSFC	LBM/BHP-HR	6.127	5.627	1.840	1.884	0.606	0.565	0.565
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.41865	1.51889	0.29111	0.12011	0.29659	0.0	0.0
BRAKE SPECIFIC HC	LBM/BHP-HR	1.24175	0.94567	0.03267	0.01460	0.00246	0.0	0.0
HC MASS / MODE	LB	0.02364	0.02531	0.05337	0.02202	0.02966	0.0	0.0
CO EMISSION RATE	LB/HR	2.77115	5.38622	10.32319	4.79690	37.13156	0.0	0.0
BRAKE SPECIFIC CO	LBM/BHP-HR	2.42568	3.36767	1.15849	0.58318	0.30837	0.0	0.0
CO MASS / MODE	LB	0.04619	0.08977	1.89258	0.87943	3.71316	0.0	0.0
NOX EMISSION RATE	LB/HR	0.00641	0.00679	0.02317	0.02489	0.67055	2.01799	1.67081
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00562	0.00424	0.00260	0.00303	0.00557	0.01676	0.01388
NOX MASS / MODE	LB	0.00011	0.00011	0.00425	0.00456	0.06706	0.20180	0.16708
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.07149	0.08329	0.07807	0.07037	0.07466	0.06351	0.05931
DIFF. CALC & MEAS F/A	PERCENT	-3.69	10.24	6.33	8.16	4.57	3.84	3.89
DIFF EV & CB RATE	PERCENT	0.05	0.57	0.76	1.15	0.45	0.0	0.0
SUM OF MOLE FRACTIONS		0.98028	1.03659	1.02200	1.02674	1.00467	0.99591	0.99633

IO-520-D S/N 559025 TEST 11 LEAN OUT C DEG BTC RUNS 80,82,83 03/27/75

PBARC	TCRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.036	69.00	64.00	2.1250	70.00	300.00	520.00	3.000 5.550	1.143

	UNITS	MODE 1	MODE 2	MODE 2	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	80.	82.	83.				
TIME IN MODE	MINUTES	1.00	11.00	11.00				
FUEL FLOW	LB/HR	7.50	19.00	17.30				
INDUCTION AIR FLOW (W)	LB/HR	125.00	250.00	240.00				
HYDROCARBON CONC.	PPM-C W	17500.00	4000.00	1250.00				
OXIDES OF NITROGEN CONC	PPM W	30.00	60.00	67.50				
CARBON MONOXIDE CONC.	PERCENT	2.95	7.70	4.20				
CARBON DIOXIDE CONC.	PERCENT	9.25	9.50	11.30				
OXYGEN CONC.	PERCENT	5.25	0.50	0.50				
WET CORRECTION FACTOR	--	0.84600	0.84600	0.84696				
OBS. TORQUE	FT-LB	10.00	40.00	40.00				
OBS. SPEED	RPM	600.00	1200.00	1200.00				
MFLD PRESSURE	IN HG ABS DRY	20.00	16.00	16.30				
INDUCTION AIR TEMP	DEG F	66.00	72.00	70.00				
COOLING AIR TEMP	DEG F	0.0	0.0	0.0				
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0				
MAX CYL HEAD TEMP	DEG F	382.00	328.00	377.00				
EXHAUST GAS TEMP	DEG F	630.00	550.00	0.0				
INDUCTION F/A RATIO (D)	LB/LB	0.06069	0.07688	0.07292				
IND. F/A EQUIV. RATIO	--	0.91	1.15	1.09				
ENGINE OBSERVED POWER	HP	1.16	9.16	9.16				
OBS BMEP	PSI	2.90	11.60	11.60				
OBS BSFC	LBM/BHP-HR	6.565	2.079	1.893				
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.06600	0.49866	0.15998				
BRAKE SPECIFIC HC	LBM/BHP-HR	0.93310	0.05453	0.01750				
HC MASS / MODE	LB	0.01777	0.09137	0.02933				
CO EMISSION RATE	LB/HR	3.06901	16.38452	9.19059				
BRAKE SPECIFIC CO	LBM/BHP-HR	2.68641	1.79276	1.00560				
CO MASS / MODE	LB	0.05115	3.00383	1.68494				
NOX EMISSION RATE	LB/HR	0.00606	0.02479	0.02865				
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00530	0.00271	0.00313				
NOX MASS / MODE	LB	0.00010	0.00454	0.00525				
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.06673	0.08515	0.07513				
DIFF. CALC & MEAS F/A	PERCENT	9.95	10.76	3.03				
DIFF EV & CB RATE	PERCENT	0.10	1.53	0.05				
SUM OF MOLE FRACTIONS		1.05144	1.07473	0.99381				

D-14

IO-520-D S/N 559025 TEST 13 BASELINE 22 DEG BTC RUNS 89-95 03/24/75

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.761	75.00	73.00	2.1250	80.00	300.00	520.00	3.000 5.550	1.672

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	89.	90.	91.	92.	93.	94.	95.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.20	17.20	146.00	121.00	78.00	16.90	7.60	
INDUCTION AIR FLOW (W)	LB/HR	90.00	195.00	1770.00	1475.00	880.00	195.00	95.00	
HYDROCARBON CONC.	PPM-C W	50500.00	26000.00	1950.00	1100.00	1700.00	27500.00	51000.00	
OXIDES OF NITROGEN CONC	PPM W	25.00	35.00	250.00	225.00	90.00	35.00	50.00	
CARBON MONOXIDE CONC.	PERCENT	3.75	8.70	7.70	8.40	10.35	9.00	2.75	
CARBON DIOXIDE CONC.	PERCENT	7.00	7.30	9.40	9.00	7.70	7.00	4.75	
OXYGEN CONC.	PERCENT	6.75	2.37	0.50	0.40	0.37	2.50	11.75	
WET CORRECTION FACTOR	--	0.88632	0.84514	0.85095	0.84322	0.85001	0.83730	0.97957	
PROP. TORQUE	FT-LB	10.00	35.00	521.00	492.00	255.00	38.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.20	13.00	28.80	28.10	18.40	13.00	15.00	
INDUCTION AIR TEMP	DEG F	77.00	76.00	82.00	82.00	81.00	79.00	77.00	
COOLING AIR TEMP	DEG F	0.0	90.00	90.00	90.00	90.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.50	1.50	1.50	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	251.00	350.00	460.00	440.00	366.00	316.00	315.00	
EXHAUST GAS TEMP	DEG F	390.00	670.00	1400.00	1330.00	1155.00	665.00	345.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08136	0.08970	0.08389	0.08343	0.09014	0.08814	0.08136	0.08780 TA
IND. F/A EQUIV. RATIO	--	1.22	1.34	1.26	1.25	1.35	1.32	1.22	1.31 TA
ENGINE OBSERVED POWER	HP	1.16	8.00	282.72	240.29	120.41	8.68	1.16	
CBS BMEP	PSI	2.90	10.15	151.09	142.68	73.95	11.02	2.90	
CBS BSFC	LBM/BHP-HR	6.302	2.151	0.516	0.504	0.648	1.946	6.653	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.44532	2.71547	1.89284	0.88278	0.83804	2.82190	3.05306	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.14047	0.34006	0.00670	0.00367	0.00696	0.32501	2.67245	
HC MASS / MODE	LB	0.04076	0.45857	0.00946	0.07356	0.08380	0.14109	0.05088	0.89814
HC MASS / RATED HP	LB/HP								0.00299
HC - PERCENT OF EPA STANDARD									157.57
CO EMISSION RATE	LB/HR	3.24903	15.52553	128.39896	114.75371	87.55220	15.61058	3.25552	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.84398	1.94163	0.45415	0.47757	0.72711	1.79795	2.84967	
CO MASS / MODE	LB	0.05415	2.84635	0.64199	9.56281	8.75522	0.78053	0.05426	22.69527
CO MASS / RATED HP	LB/HP								0.07565
CO - PERCENT OF EPA STANDARD									180.12
NOX EMISSION RATE	LB/HR	0.00401	0.01214	0.80468	0.59875	0.14712	0.01191	0.00993	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00351	0.00152	0.00285	0.00249	0.00122	0.00137	0.00869	
NOX MASS / MODE	LB	0.00007	0.00223	0.00402	0.04990	0.01471	0.00060	0.00017	0.07168
NOX MASS / RATED HP	LB/HP								0.00024
NOX- PERCENT OF EPA STANDARD									15.93
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08193	0.09602	0.08412	0.08597	0.09271	0.09776	0.06117	0.09172 TA
DIFF. CALC & MEAS F/A	PERCENT	0.69	7.04	0.28	3.04	2.85	10.92	-24.82	4.46 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.18	-2.39	
SUM OF MOLE FRACTIONS		0.99580	1.02505	1.00753	1.01631	1.00778	1.04192	0.90171	

IO-520-D S/N 559025 TEST 14 LEAN 22 DEG BTC RUNS 96-102 03/26/75

EBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.262	63.00	49.00	2.1250	70.00	300.00	520.00	3.000	5.550	0.415

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	96.	97.	98.	99.	100.	101.	102.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.70	14.60	143.00	107.00	63.00	14.10	9.00	
INDUCTION AIR FLOW (W)	LB/HR	110.00	173.00	1750.00	1410.00	830.00	170.00	110.00	
HYDROCARBON CONC.	PPM-C W	35000.00	16500.00	1650.00	800.00	1200.00	18500.00	36000.00	
OXIDES OF NITROGEN CONC	PPM W	37.50	50.00	375.00	690.00	440.00	50.00	35.00	
CARBON MONOXIDE CONC.	PERCENT	3.95	6.50	7.20	5.15	6.20	7.00	4.20	
CARBON DIOXIDE CONC.	PERCENT	8.50	9.25	9.75	10.75	10.25	8.75	8.50	
OXYGEN CONC.	PERCENT	4.50	1.50	0.50	0.50	0.25	1.50	4.25	
WET CORRECTION FACTOR	--	0.88499	0.86719	0.86429	0.86268	0.85782	0.85782	0.88726	
FRCP. TORQUE	FT-LB	17.00	40.00	530.00	492.00	255.00	40.00	17.00	
FRCP. SPEED	RPM	800.00	1200.00	2850.00	2565.00	2480.00	1200.00	800.00	
MFLD PRESSURE	IN HG ABS DRY	14.30	12.70	28.75	27.70	18.00	12.90	14.50	
INDUCTION AIR TEMP	DEG F	64.00	65.00	73.00	76.00	75.00	73.00	73.00	
COOLING AIR TEMP	DEG F	0.0	0.0	79.00	78.00	79.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	2.80	2.00	2.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	322.00	310.00	460.00	440.00	358.00	310.00	320.00	
EXHAUST GAS TEMP	DEG F	515.00	680.00	1420.00	1385.00	1225.00	660.00	495.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07942	0.08474	0.08205	0.07620	0.07622	0.08329	0.08216	0.08083 TA
IND. F/A EQUIV. RATIO	--	1.19	1.27	1.23	1.14	1.14	1.25	1.23	1.21 TA
ENGINE OBSERVED POWER	HP	2.59	9.16	287.60	240.29	120.41	9.14	2.59	
CBS BMEP	PSI	4.93	11.60	153.70	142.68	73.95	11.60	4.93	
CBS BSFC	LBM/BHP-HR	3.360	1.597	0.497	0.445	0.523	1.543	3.476	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.05630	1.54284	1.56147	0.60829	0.52082	1.66490	2.13647	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.79409	0.16881	0.00543	0.00253	0.00433	0.18217	0.82505	
HC MASS / MODE	LB	0.03427	0.28285	0.00781	0.05069	0.05208	0.08325	0.03561	0.54656
HC MASS / RATED HP	LB/HP								0.00182
HC - PERCENT OF EPA STANDARD									95.89
CO EMISSION RATE	LB/HR	4.14610	10.64021	118.88577	68.19676	46.59979	10.90935	4.46457	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.60112	1.16422	0.41337	0.28382	0.38701	1.19366	1.72411	
CO MASS / MODE	LB	0.06910	1.95070	0.59443	5.68306	4.65998	0.54547	0.07441	13.57715
CO MASS / RATED HP	LB/HP								0.04526
CO - PERCENT OF EPA STANDARD									107.76
NOX EMISSION RATE	LB/HR	0.00731	0.01550	1.17676	1.73971	0.63324	0.01492	0.00689	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00282	0.00170	0.00409	0.00724	0.00526	0.00163	0.00266	
NOX MASS / MODE	LB	0.00012	0.00284	0.00588	0.14498	0.06332	0.00075	0.00011	0.21801
NOX MASS / RATED HP	LB/HP								0.00073
NOX- PERCENT OF EPA STANDARD									48.45
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08078	0.08628	0.08252	0.07711	0.08076	0.08925	0.08272	0.08334 TA
DIFF. CALC & MEAS F/A	PERCENT	1.71	1.81	0.57	1.19	5.96	7.16	0.68	3.11 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.75	0.36	0.05	
SUM OF MOLE FRACTIONS		0.99528	1.00579	1.01037	0.99284	1.02091	1.01832	0.99166	

10-520-D S/N 559025 TEST 15 BASELINE 22 DEG BTC RUNS 103-109 04/03/75

PBARC IN HG ABS	TCRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.184	51.50	43.00	2.1250	55.00	300.00	520.00	8.000 5.550	0.351

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	103.	104.	105.	106.	107.	108.	109.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.50	14.50	143.00	114.00	75.00	14.90	6.40	
INDUCTION AIR FLOW (W)	LB/HR	85.00	175.00	1780.00	1460.00	850.00	175.00	80.00	
HYDROCARBON CONC.	PPM-C W	43000.00	18000.00	1650.00	900.00	1650.00	17500.00	40000.00	
OXIDES OF NITROGEN CONC	PPM W	43.70	50.00	375.00	440.00	125.00	50.00	43.70	
CARBON MONOXIDE CONC.	PERCENT	2.80	7.60	7.00	6.70	10.35	7.70	2.32	
CARBON DIOXIDE CONC.	PERCENT	7.50	8.60	9.95	9.90	7.85	8.75	7.85	
OXYGEN CONC.	PERCENT	6.80	1.87	0.50	0.37	0.37	1.37	6.80	
WET CORRECTION FACTOR	--	0.96939	0.85821	0.86045	0.85821	0.85957	0.85821	0.94688	
PROP. TORQUE	FT-LB	10.00	38.00	535.00	491.00	254.00	38.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS	DRY	16.50	12.80	28.70	27.50	18.10	12.90	15.50	
INDUCTION AIR TEMP	DEG F	54.00	55.00	65.00	66.00	65.00	62.00	61.00	
COOLING AIR TEMP	DEG F	0.0	0.0	71.00	75.00	71.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.80	1.80	1.80	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	232.00	310.00	460.00	432.00	335.00	326.00	290.00	
EXHAUST GAS TEMP	DEG F	370.00	660.00	1420.00	1365.00	1160.00	685.00	400.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08858	0.08316	0.08065	0.07839	0.08858	0.08548	0.08031	0.08381 TA
IND. F/A EQUIV. RATIO	--	1.33	1.24	1.21	1.17	1.33	1.28	1.20	1.25 TA
ENGINE OBSERVED POWER	HP	1.16	8.68	290.32	239.80	119.96	8.68	1.16	
CBS BMEP	PSI	2.90	11.02	155.15	142.39	73.66	11.02	2.90	
CBS BSFC	LBM/BHP-HR	6.565	1.670	0.493	0.475	0.625	1.716	5.602	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.21366	1.62556	1.56837	0.70165	0.76744	1.61110	1.86146	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.93750	0.18768	0.00540	0.00293	0.00640	0.18556	1.61189	
HC MASS / MODE	LB	0.03689	0.29875	0.00784	0.05847	0.07674	0.08055	0.03069	0.58994
HC MASS / RATED HP	LB/HP								0.00197
HC - PERCENT OF EPA STANDARD									103.50
CO EMISSION RATE	LB/HR	2.82040	11.92033	115.57768	90.49646	83.53506	12.28163	2.04159	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.46896	1.37294	0.39811	0.37739	0.69648	1.41456	1.78708	
CO MASS / MODE	LB	0.04701	2.18539	0.57789	7.54137	8.35350	0.61408	0.03403	19.35324
CO MASS / RATED HP	LB/HP								0.06451
CO - PERCENT OF EPA STANDARD									153.60
NOX EMISSION RATE	LB/HR	0.00746	0.01501	1.18196	1.13745	0.19279	0.01526	0.00667	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00653	0.00173	0.00407	0.00474	0.00161	0.00176	0.00584	
NOX MASS / MODE	LB	0.00012	0.00275	0.00591	0.09479	0.01928	0.00076	0.00011	0.12373
NOX MASS / RATED HP	LB/HP								0.00041
NOX- PERCENT OF EPA STANDARD									27.49
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07316	0.08870	0.08191	0.08148	0.09231	0.09043	0.07096	0.08707 TA
DIFF. CALC & MEAS F/A	PERCENT	-17.41	6.63	1.55	3.94	4.21	5.79	-11.65	3.89 TA
DIFF EV & CB RATE	PERCENT	0.05	0.35	0.05	0.28	0.05	0.28	0.05	
SUM OF MOLE FRACTIONS		0.91966	1.04592	1.01774	1.00935	1.02119	1.03359	0.94226	

10-520-D S/N 559025 TEST 16 BASELINE *NEW SPARK PLUGS* RUNS 110-116 04/04/75

FBARO	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.270	56.00	45.00	2.1250	60.00	300.00	520.00	3.000	5.550	0.380

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	110.	111.	112.	113.	114.	115.	116.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	5.50	14.00	143.00	112.00	75.00	14.40	7.30	
INDUCTION AIR FLOW (W)	LB/HR	70.00	160.00	1790.00	1445.00	845.00	165.00	75.00	
HYDROCARBON CONC.	PPM-C W	41000.00	15000.00	1700.00	850.00	1600.00	18500.00	39000.00	
OXIDES OF NITROGEN CONC	PPM W	37.50	47.50	425.00	525.00	125.00	50.00	31.25	
CARBON MONOXIDE CONC.	PERCENT	2.32	7.00	6.75	6.30	10.35	7.50	2.16	
CARBON DIOXIDE CONC.	PERCENT	8.30	9.00	10.00	10.50	8.00	8.50	8.30	
OXYGEN CONC.	PERCENT	6.75	1.62	0.37	0.37	0.37	1.50	6.75	
WET CORRECTION FACTOR	--	0.96040	0.87151	0.85944	0.85838	0.86128	0.86586	0.99559	
PROP. TORQUE	FT-LB	10.00	40.00	546.00	492.00	255.00	40.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.60	12.70	28.80	27.30	17.80	12.50	15.50	
INDUCTION AIR TEMP	DEG F	56.00	54.00	63.00	63.00	61.00	59.00	57.00	
COOLING AIR TEMP	DEG F	0.0	0.0	65.00	68.00	69.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	1.80	1.80	1.80	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	212.00	245.00	458.00	441.00	351.00	253.00	210.00	
EXHAUST GAS TEMP	DEG F	345.00	620.00	1420.00	1365.00	1150.00	643.00	345.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08461	0.08783	0.08019	0.07780	0.08910	0.08761	0.09770	0.08641 TA
IND. F/A EQUIV. RATIO	--	1.27	1.31	1.20	1.16	1.33	1.31	1.46	1.29 TA
ENGINE OBSERVED POWER	HP	1.14	9.14	296.29	240.29	120.41	9.14	1.14	
OBS BMEP	PSI	2.90	11.60	158.34	142.68	73.95	11.60	2.90	
OBS BSFC	LBM/BHP-HR	5.164	1.532	0.483	0.466	0.623	1.576	6.390	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.65854	1.64597	1.63631	0.64343	0.73694	1.66318	1.95002	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.45177	0.18010	0.00552	0.00268	0.00612	0.18198	1.70692	
HC MASS / MODE	LB	0.02764	0.30176	0.00818	0.05362	0.07369	0.08316	0.03250	0.58056
HC MASS / RATED HP	LB/HP								0.00194
HC - PERCENT OF EPA STANDARD									101.85
CO EMISSION RATE	LB/HR	1.81957	10.66902	112.72534	82.64038	82.88698	11.78591	2.17068	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.59273	1.16737	0.38046	0.34393	0.68837	1.28957	1.90007	
CO MASS / MODE	LB	0.03033	1.95599	0.56363	6.88670	8.28870	0.58930	0.03618	18.35078
CO MASS / RATED HP	LB/HP								0.06117
CO - PERCENT OF EPA STANDARD									145.64
NOX EMISSION RATE	LB/HR	0.00503	0.01364	1.35648	1.31781	0.19091	0.01491	0.00518	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00440	0.00149	0.00458	0.00548	0.00159	0.00163	0.00454	
NOX MASS / MODE	LB	0.00008	0.00250	0.00678	0.10982	0.01909	0.00075	0.00009	0.13911
NOX MASS / RATED HP	LB/HP								0.00046
NOX- PERCENT OF EPA STANDARD									30.91
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07120	0.08641	0.08191	0.08003	0.09193	0.09050	0.06918	0.08647 TA
DIFF. CALC & MEAS F/A	PERCENT	-15.85	0.65	2.14	2.86	3.18	3.30	-29.20	0.07 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.30	0.05	0.05	-1.42	
SUM OF MOLE FRACTIONS		0.95206	1.01250	1.00776	1.02663	1.02710	1.00487	0.87035	

D-19

IO-520-D S/N 559025 TEST 17 LEAN 22 DEG BTC RUNS 118,120-125 04/04/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.930	76.00	71.00	2.1250	82.00	300.00	520.00	3.000 5.550	1.491

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	118.	120.	121.	122.	123.	124.	125.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.40	12.50	143.00	103.00	59.00	12.70	6.00	
INDUCTION AIR FLOW (W)	LB/HR	80.00	170.00	1700.00	1400.00	825.00	170.00	80.00	
HYDROCARBON CONC.	PPM-C W	40000.00	9500.00	1900.00	675.00	950.00	8250.00	44000.00	
OXIDES OF NITROGEN CONC	PPM W	35.00	55.00	310.00	1125.00	800.00	51.25	50.00	
CARBON MONOXIDE CONC.	PERCENT	2.16	4.90	7.20	3.30	3.50	5.30	2.53	
CARBON DIOXIDE CONC.	PERCENT	7.70	10.25	9.75	11.70	11.60	10.50	7.30	
OXYGEN CONC.	PERCENT	7.25	1.00	0.13	0.17	0.17	0.75	7.50	
WET CORRECTION FACTOR	--	0.94805	0.84029	0.85787	0.85802	0.84574	0.84029	0.91293	
PROP. TORQUE	FT-LB	8.00	34.00	524.00	480.00	248.00	35.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2565.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.50	12.50	28.80	27.40	17.90	12.80	16.00	
INDUCTION AIR TEMP	DEG F	81.00	80.00	86.00	86.00	85.00	84.00	83.00	
COOLING AIR TEMP	DEG F	0.0	0.0	93.00	94.00	94.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.20	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	264.00	341.00	450.00	460.00	375.00	340.00	316.00	
EXHAUST GAS TEMP	DEG F	360.00	710.00	1420.00	1425.00	1280.00	712.00	350.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08121	0.07464	0.08539	0.07468	0.07260	0.07584	0.07613	0.07474 TA
IND. F/A EQUIV. RATIO	--	1.21	1.12	1.28	1.12	1.09	1.13	1.14	1.12 TA
ENGINE OBSERVED POWER	HP	0.91	7.77	284.35	234.42	117.11	8.00	0.91	
OBS BMEP	PSI	2.32	5.86	151.96	139.20	71.92	10.15	2.32	
OBS BSFC	LBM/BHP-HR	7.003	1.609	0.503	0.439	0.504	1.588	6.565	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.88035	0.85103	1.80830	0.52685	0.42712	0.72845	1.93531	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.05742	0.10955	0.00636	0.00225	0.00365	0.09109	2.11755	
HC MASS / MODE	LB	0.03134	0.15602	0.00904	0.04390	0.04271	0.03642	0.03226	0.35170
HC MASS / RATED HP	LB/HP								0.00117
HC - PERCENT OF EPA STANDARD									61.70
CO EMISSION RATE	LB/HR	1.94335	7.44615	118.67409	44.61525	26.86702	7.93846	2.05088	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.12635	0.95851	0.41735	0.19032	0.22943	0.99269	2.24500	
CO MASS / MODE	LB	0.03239	1.36513	0.59337	3.71794	2.68670	0.39692	0.03418	8.82663
CO MASS / RATED HP	LB/HP								0.02942
CO - PERCENT OF EPA STANDARD									70.05
NOX EMISSION RATE	LB/HR	0.00546	0.01634	0.97833	2.91170	1.19269	0.01501	0.00729	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00597	0.00210	0.00344	0.01242	0.01018	0.00188	0.00798	
NOX MASS / MODE	LB	0.00009	0.00300	0.00489	0.24264	0.11927	0.00075	0.00012	0.37076
NOX MASS / RATED HP	LB/HP								0.00124
NOX- PERCENT OF EPA STANDARD									82.39
** DATA VALIDITY CHECKS FOR ENGIO7 **									
CAL. FUEL AIR RATIO	LB/LB	0.06912	0.08029	0.08415	0.07394	0.07455	0.08099	0.07213	0.07727 TA
DIFF. CALC & MEAS F/A	PERCENT	-14.89	7.56	-1.45	-1.00	2.70	6.79	-5.26	3.38 TA
DIFF EV & CB RATE	PERCENT	0.05	0.45	0.05	0.05	0.05	0.58	0.05	
SUM OF MOLE FRACTIONS		0.93445	1.00483	0.98854	0.95721	0.97096	1.02402	0.97335	

IO-520-DCL S/N 559025 POST FLIGHT TEST - TEST 1A BASELINE RUNS 1-7 09/14/76

FBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.175	76.00	68.00	2.1250	76.00	300.00	520.00	3.000	5.550	1.265

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.00	117.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	81.00	185.00	1799.00	1580.00	920.00	183.00	80.50	
HYDROCARBON CONC.	PPM-C W	48750.00	30000.00	5025.00	2400.00	1980.00	36750.00	58500.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	17.50	180.00	490.00	470.00	12.50	7.50	
CARBON MONOXIDE CONC.	PERCENT	4.50	9.00	9.45	6.60	6.40	9.75	5.20	
CARBON DIOXIDE CONC.	PERCENT	8.05	8.25	9.00	11.05	11.15	7.30	7.60	
OXYGEN CONC.	PERCENT	5.50	1.75	0.0	0.0	0.0	2.12	5.50	
WET CORRECTION FACTOR	--	0.88756	0.84399	0.84399	0.84399	0.84399	0.84399	0.85900	
PROP. TORQUE	FT-LB	10.00	30.00	493.00	494.00	261.00	30.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.50	12.50	26.71	27.70	18.00	12.60	15.00	
INDUCTION AIR TEMP	DEG F	84.00	83.00	88.00	88.00	86.00	86.00	88.00	
COOLING AIR TEMP	DEG F	98.00	96.00	96.00	96.00	94.00	99.00	99.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	1.70	1.70	1.70	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	240.00	278.00	435.00	455.00	391.00	308.00	256.00	
EXHAUST GAS TEMP	DEG F	415.00	0.0	1390.00	1350.00	1245.00	650.00	400.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08753	0.09197	0.08276	0.07500	0.07486	0.09298	0.08807	0.08481 TA
IND. F/A EQUIV. RATIO	--	1.31	1.38	1.24	1.12	1.12	1.39	1.32	1.27 TA
ENGINE OBSERVED POWER	HP	1.14	6.85	267.53	242.20	123.24	6.85	1.14	
OBS BMEP	PSI	2.90	8.70	142.97	143.26	75.69	8.70	2.90	
OBS BSFC	LBM/BHP-HP	6.127	2.451	0.549	0.483	0.552	2.451	6.127	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HP	2.08922	2.81411	4.50539	1.81876	0.87943	3.35069	2.38335	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.82877	0.41055	0.01684	0.00751	0.00714	0.48883	2.08622	
HC MASS / MODE	LB	0.03482	0.51592	0.02253	0.15157	0.08794	0.16753	0.03972	1.02003
HC MASS / RATED HP	LB/HP								0.00340
HC - PERCENT OF EPA STANDARD									178.95
CO EMISSION RATE	LB/HP	3.45547	14.38430	144.36258	85.21950	48.43283	15.14635	3.67378	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.02465	2.09651	0.53962	0.35185	0.39298	2.20968	3.21578	
CO MASS / MODE	LB	0.05759	2.63712	0.72181	7.10162	4.84328	0.75732	0.06123	16.17596
CO MASS / RATED HP	LB/HP								0.05393
CO - PERCENT OF EPA STANDARD									128.41
NOX EMISSION RATE	LB/HP	0.00142	0.00544	0.53515	1.23132	0.69221	0.00378	0.00101	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00124	0.00079	0.00200	0.00508	0.00562	0.00055	0.00089	
NOX MASS / MODE	LB	0.00002	0.00100	0.00268	0.10261	0.06922	0.00019	0.00002	0.17573
NOX MASS / RATED HP	LB/HP								0.00059
NOX - PERCENT OF EPA STANDARD									39.05

** DATA VALIDITY CHECKS FOR ENGIO7 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08582	0.09523	0.09178	0.08220	0.08151	0.10520	0.09397	0.09211 TA
DIFF. CALC & MEAS F/A	PERCENT	-1.96	7.89	10.90	9.59	8.88	13.15	6.70	8.61 TA
DIFF EV & CB RATE	PERCENT	0.05	0.55	1.63	1.87	1.73	1.11	0.05	
SUM OF MOLE FRACTIONS		1.02627	1.06543	1.09302	1.10809	1.10094	1.10164	1.05924	

10-520-DCL S/N 559025 POST FLIGHT TEST - TEST 2A BASELINE RUNS 8-14 09/14/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.155	82.50	70.50	2.1250	82.50	300.00	520.00	3.000 5.550	1.307

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.50	117.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	76.00	183.00	1782.00	1561.00	908.00	182.00	80.00	
HYDROCARBON CONC.	PPM-C W	63750.00	32250.00	4800.00	2250.00	1995.00	34500.00	56250.00	
OXIDES OF NITROGEN CONC	PPM W	7.50	16.00	190.00	440.00	470.00	13.00	7.00	
CARBON MONOXIDE CONC.	PERCENT	5.25	9.25	9.30	6.90	6.45	9.65	5.35	
CARBON DIOXIDE CONC.	PERCENT	7.35	7.95	9.30	10.80	11.05	7.40	7.50	
OXYGEN CONC.	PERCENT	6.00	4.62	0.13	0.13	0.13	2.25	5.62	
WET CORRECTION FACTOR	--	0.87868	0.87820	0.84332	0.84332	0.84332	0.84332	0.86716	
PROP. TORQUE	FT-LB	10.00	28.00	496.00	490.00	263.00	29.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.50	12.70	27.75	27.70	18.00	13.00	15.50	
INDUCTION AIR TEMP	DEG F	89.00	87.00	93.00	93.00	91.00	92.00	93.00	
COOLING AIR TEMP	DEG F	104.00	106.00	105.00	105.00	103.00	106.00	107.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	1.80	1.80	1.80	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	263.00	285.00	446.00	454.00	397.00	316.00	269.00	
EXHAUST GAS TEMP	DEG F	415.00	650.00	1385.00	1360.00	1240.00	655.00	410.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09332	0.09302	0.08387	0.07594	0.07588	0.09353	0.08866	0.08593 TA
IND. F/A EQUIV. RATIO	--	1.40	1.39	1.25	1.14	1.14	1.40	1.33	1.29 TA
ENGINE OBSERVED POWER	HP	1.14	6.40	269.15	240.24	124.19	6.63	1.16	
OBS BMEP	PSI	2.90	8.12	143.84	142.10	76.27	8.41	2.90	
OBS BSFC	LBM/BHP-HR	6.127	2.626	0.548	0.487	0.548	2.535	6.127	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.50774	2.89750	4.29385	1.70339	0.88920	3.18728	2.30223	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.19511	0.45297	0.01595	0.00709	0.00716	0.48102	2.01521	
HC MASS / MODE	LB	0.04180	0.53128	0.02147	0.14195	0.08892	0.15936	0.03837	1.02315
HC MASS / RATED HP	LB/HP								0.00341
HC - PERCENT OF EPA STANDARD									179.50
CO EMISSION RATE	LB/HR	3.66335	14.73588	141.63374	88.93225	48.94341	15.17773	3.83323	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.20665	2.30336	0.52622	0.37018	0.39410	2.29062	3.35536	
CO MASS / MODE	LB	0.06106	2.70158	0.70817	7.41102	4.89434	0.75889	0.06389	16.59891
CO MASS / RATED HP	LB/HP								0.05533
CO - PERCENT OF EPA STANDARD									131.74
NOX EMISSION RATE	LB/HR	0.00098	0.00477	0.56359	1.10456	0.69464	0.00398	0.00095	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00086	0.00075	0.00209	0.00460	0.00559	0.00060	0.00083	
NOX MASS / MODE	LB	0.00002	0.00087	0.00282	0.09205	0.06946	0.00020	0.00002	0.16543
NOX MASS / RATED HP	LB/HP								0.00055
NOX- PERCENT OF EPA STANDARD									36.76
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09450	0.08894	0.09028	0.08247	0.08126	0.10281	0.09233	0.08793 TA
DIFF. CALC & MEAS F/A	PERCENT	1.26	-4.39	7.64	8.59	7.09	9.92	4.14	2.33 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	1.15	1.61	1.33	0.54	0.05	
SUM OF MOLE FRACTIONS		1.05224	1.14857	1.09112	1.10119	1.08811	1.08752	1.05488	

IO-520-DCL S/N 559025 POST FLIGHT TEST - TEST 3A BASELINE RUNS 15-21 09/14/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.155	82.50	70.50	2.1250	82.50	300.00	520.00	3.000 5.550	1.307

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.50	117.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	80.00	187.00	1779.00	1555.00	907.00	189.00	80.00	
HYDROCARBON CONC.	PPM-C W	54000.00	30000.00	4500.00	2025.00	1800.00	33750.00	54000.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	17.50	180.00	450.00	470.00	14.00	6.00	
CARBON MONOXIDE CONC.	PERCENT	5.00	5.25	9.45	6.85	6.35	9.30	4.70	
CARBON DIOXIDE CONC.	PERCENT	7.90	7.95	9.10	10.70	10.95	7.50	7.70	
OXYGEN CONC.	PERCENT	5.50	2.00	0.13	0.13	0.13	2.25	5.75	
WET CORRECTION FACTOR	--	0.87341	0.84332	0.84332	0.84332	0.84332	0.84332	0.88239	
PROP. TORQUE	FT-LB	10.00	30.00	496.00	485.00	260.00	30.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
FELD PRESSURE	IN HG ABS DRY	15.50	12.60	28.75	27.10	18.00	12.60	15.70	
INDUCTION AIR TEMP	DEG F	93.00	90.00	95.00	95.00	93.00	93.00	94.00	
COOLING AIR TEMP	DEG F	108.00	107.00	106.00	105.00	104.00	108.00	108.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	2.00	2.00	2.00	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	276.00	286.00	443.00	453.00	396.00	318.00	268.00	
EXHAUST GAS TEMP	DEG F	435.00	650.00	1400.00	1360.00	1250.00	655.00	410.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08866	0.09103	0.08401	0.07624	0.07596	0.09007	0.08866	0.08465 TA
IND. F/A EQUIV. RATIO	--	1.33	1.36	1.26	1.14	1.14	1.35	1.33	1.27 TA
ENGINE OBSERVED POWER	HP	1.14	6.85	270.24	237.79	122.77	6.85	1.14	
OBS BMEP	PSI	2.90	8.70	144.42	140.65	75.40	8.70	2.90	
OBS BSFC	LBM/BHP-HR	6.127	2.451	0.546	0.492	0.554	2.451	6.127	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.22353	2.82276	4.04353	1.54828	0.81251	3.16879	2.26780	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.94633	0.41181	0.01496	0.00651	0.00662	0.46229	1.98508	
HC MASS / MODE	LB	0.03706	0.51751	0.02022	0.12902	0.08125	0.15844	0.03780	0.98129
HC MASS / RATED HP	LB/HP								0.00327
HC - PERCENT OF EPA STANDARD									172.16
CO EMISSION RATE	LB/HR	3.63015	14.81746	144.56348	89.16467	48.79849	14.86555	3.51606	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.17760	2.16170	0.53495	0.37497	0.39747	2.16872	3.07773	
CO MASS / MODE	LB	0.06050	2.71653	0.72282	7.43039	4.87985	0.74328	0.05860	16.61195
CO MASS / RATED HP	LB/HP								0.05537
CO - PERCENT OF EPA STANDARD									131.84
NOX EMISSION RATE	LB/HR	0.00123	0.00546	0.53632	1.14089	0.70349	0.00436	0.00084	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00108	0.00080	0.00198	0.00480	0.00573	0.00064	0.00073	
NOX MASS / MODE	LB	0.00002	0.00100	0.00268	0.09507	0.07035	0.00022	0.00001	0.16936
NOX MASS / RATED HP	LB/HP								0.00056
NOX- PERCENT OF EPA STANDARD									37.64
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09012	0.09925	0.09075	0.08237	0.08108	0.10157	0.08866	0.09161 TA
DIFF. CALC & MEAS F/A	PERCENT	1.64	9.04	8.02	8.05	6.74	12.77	0.00	8.22 TA
DIFF EV & CB RATE	PERCENT	0.05	0.64	1.13	1.43	1.17	1.08	0.05	
SUM OF MOLE FRACTIONS		1.05117	1.09258	1.08541	1.08769	1.07386	1.09930	1.03260	

IO-520-DCL S/N 559025 POST FLIGHT TEST - TEST 48 CASE 2 RUNS 22-28 09/15/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.090	78.00	70.00	2.1250	78.00	300.00	520.00	3.000	5.550	1.369

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	28.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.00	13.50	140.00	107.00	60.00	13.50	8.00	
INDUCTION AIR FLOW (W)	LB/HR	81.50	185.00	1790.00	1569.50	911.00	175.00	81.00	
HYDROCARBON CONC.	PPM-C W	69000.00	4875.00	4650.00	1950.00	1290.00	12600.00	73500.00	
OXIDES OF NITROGEN CONC	PPM W	6.50	40.00	310.00	1287.00	1550.00	31.50	5.00	
CARBON MONOXIDE CONC.	PERCENT	5.75	5.40	7.80	3.55	2.25	7.10	6.05	
CARBON DIOXIDE CONC.	PERCENT	6.90	11.70	10.20	12.70	13.50	10.30	6.45	
OXYGEN CONC.	PERCENT	6.25	0.25	0.13	0.13	0.13	0.50	6.63	
WET CORRECTION FACTOR	--	0.89200	0.84229	0.84229	0.84229	0.84229	0.84229	0.88879	
PROP. TORQUE	FT-LB	10.00	31.00	500.00	494.00	261.00	31.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.50	11.90	28.72	27.70	18.00	12.00	16.50	
INDUCTION AIR TEMP	DEG F	83.00	81.00	89.00	89.00	87.00	86.00	87.00	
COOLING AIR TEMP	DEG F	96.00	99.00	99.00	100.00	97.00	100.00	102.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	2.00	2.00	2.00	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	230.00	278.00	447.00	461.00	397.00	315.00	273.00	
EXHAUST GAS TEMP	DEG F	370.00	725.00	1455.00	1390.00	1315.00	680.00	400.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09952	0.07399	0.07930	0.06912	0.06678	0.07821	0.10014	0.07393 TA
IND. F/A EQUIV. RATIO	--	1.49	1.11	1.19	1.03	1.00	1.17	1.50	1.11 TA
ENGINE OBSERVED POWER	HP	1.14	7.08	271.33	242.20	123.24	7.08	1.14	
OBS BMEP	PSI	2.90	8.99	145.00	143.26	75.69	8.99	2.90	
OBS BSFC	LBM/BHP-HR	7.003	1.906	0.516	0.442	0.487	1.906	7.003	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.97620	0.43331	4.08447	1.47356	0.56651	1.04781	3.12289	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.60517	0.06118	0.01505	0.00608	0.00460	0.14793	2.73357	
HC MASS / MODE	LB	0.04960	0.07944	0.02042	0.12280	0.05665	0.05239	0.05205	0.43335
HC MASS / RATED HP	LB/HP								0.00144
HC - PERCENT OF EPA STANDARD									76.03
CO EMISSION RATE	LB/HR	4.46616	8.16151	116.49986	45.61526	16.80141	10.03967	4.61223	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.90937	1.15226	0.42937	0.18833	0.13633	1.41743	4.03724	
CO MASS / MODE	LB	0.07444	1.49628	0.58250	3.80127	1.68014	0.50198	0.07687	8.21348
CO MASS / RATED HP	LB/HP								0.02738
CO - PERCENT OF EPA STANDARD									65.19
NOX EMISSION RATE	LB/HR	0.00053	0.01179	0.90292	3.22492	2.25711	0.00869	0.00070	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00081	0.00166	0.00333	0.01331	0.01831	0.00123	0.00062	
NOX MASS / MODE	LB	0.00002	0.00216	0.00451	0.26874	0.22571	0.00043	0.00001	0.50159
NOX MASS / RATED HP	LB/HP								0.00167
NOX- PERCENT OF EPA STANDARD									111.46

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09739	0.07589	0.08613	0.07475	0.07168	0.08773	0.09977	0.07945 TA
DIFF. CALC & MEAS F/A	PERCENT	-2.14	7.99	8.62	8.15	7.34	12.17	-0.37	7.47 TA
DIFF EV & CB RATE	PERCENT	0.05	1.59	1.50	1.53	1.36	2.09	0.05	
SUM OF MOLE FRACTIONS		1.04627	1.10044	1.09835	1.08218	1.07235	1.12023	1.05443	

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10-520-DCL S/N 559025 POST FLIGHT TEST - TEST 58 CASE 2 RUNS 29-35 09/15/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.072	84.00	73.00	2.1250	84.00	300.00	520.00	3.000	5.550	1.470

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	30.	31.	32.	33.	34.	35.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.00	13.50	140.00	107.00	60.00	13.50	8.00	
INDUCTION AIR FLOW (W)	LB/HR	80.00	179.00	1786.00	1570.00	909.00	168.00	80.00	
HYDROCARBON CONC.	PPM-C W	71250.00	5600.00	4500.00	1980.00	1350.00	14400.00	75000.00	
OXIDES OF NITROGEN CONC	PPM W	5.50	35.00	320.00	1000.00	1562.50	27.00	5.00	
CARBON MONOXIDE CONC.	PERCENT	6.10	6.75	7.90	4.20	2.40	7.45	6.40	
CARBON DIOXIDE CONC.	PERCENT	6.50	10.65	10.20	12.30	13.35	9.95	6.25	
OXYGEN CONC.	PERCENT	6.50	0.50	0.13	0.13	0.13	0.75	6.50	
WET CORRECTION FACTOR	--	0.89494	0.84063	0.84063	0.84063	0.84063	0.84063	0.88366	
PROP. TORQUE	FT-LB	10.00	30.00	501.00	490.00	260.00	30.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.00	11.90	28.70	27.70	18.00	12.00	16.10	
INDUCTION AIR TEMP	DEG F	91.00	90.00	93.00	93.00	92.00	92.00	92.00	
COOLING AIR TEMP	DEG F	105.00	108.00	105.00	105.00	104.00	104.00	108.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	2.00	2.00	2.00	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	248.00	304.00	455.00	463.00	400.00	293.00	268.00	
EXHAUST GAS TEMP	DEG F	410.00	700.00	1440.00	1400.00	1330.00	690.00	410.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10149	0.07654	0.07956	0.06917	0.06699	0.08156	0.10149	0.07551 TA
IND. F/A EQUIV. RATIO	--	1.52	1.15	1.19	1.03	1.00	1.22	1.52	1.13 TA
ENGINE OBSERVED POWER	HP	1.14	6.85	271.87	240.24	122.77	6.85	1.14	
OBS BMEP	PSI	2.90	8.70	145.29	142.10	75.40	8.70	2.90	
OBS BSFC	LBM/BHP-HR	7.003	1.969	0.515	0.445	0.489	1.969	7.003	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	3.03654	0.81517	3.94281	1.47643	0.59375	1.18623	3.14936	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.65833	0.11892	0.01450	0.00615	0.00484	0.17306	2.75674	
HC MASS / MODE	LB	0.05062	0.14945	0.01971	0.12304	0.05937	0.05931	0.05249	0.51399
HC MASS / RATED HP	LB/HP								0.00171
HC - PERCENT OF EPA STANDARD									90.17
CO EMISSION RATE	LB/HR	4.69745	9.72694	117.46638	53.14822	17.91312	10.41494	4.79417	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.11183	1.41905	0.43207	0.22123	0.14591	1.51942	4.19650	
CO MASS / MODE	LB	0.07829	1.78327	0.58733	4.42902	1.79131	0.52075	0.07990	9.26987
CO MASS / RATED HP	LB/HP								0.03090
CO - PERCENT OF EPA STANDARD									73.57
NOX EMISSION RATE	LB/HR	0.00078	0.00985	0.92972	2.47260	2.27873	0.00738	0.00070	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00068	0.00144	0.00342	0.01029	0.01856	0.00108	0.00061	
NOX MASS / MODE	LB	0.00001	0.00181	0.00465	0.20605	0.22787	0.00037	0.00001	0.44077
NOX MASS / RATED HP	LB/HP								0.00147
NOX- PERCENT OF EPA STANDARD									97.95

** DATA VALIDITY CHECKS FOR ENGIC7 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09881	0.08501	0.08622	0.07618	0.07204	0.08887	0.10244	0.08213 TA
DIFF. CALC & MEAS F/A	PERCENT	-2.64	11.06	8.38	10.14	7.54	8.97	0.93	8.77 TA
DIFF EV & CB RATE	PERCENT	0.05	1.97	1.46	1.91	1.35	1.35	0.05	
SUM OF MOLE FRACTIONS		1.04550	1.12044	1.10042	1.09761	1.06972	1.09843	1.05537	

IO-520-DCL S/N 559025 POST FLIGHT TEST - TEST 6B CASE 2 RUNS 36-42 09/15/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.070	84.00	73.00	2.1250	84.00	300.00	520.00	3.000 5.550	1.470

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	36.	37.	38.	39.	40.	41.	42.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.00	13.50	140.00	107.00	60.00	13.50	8.00	
INDUCTION AIR FLOW (W)	LB/HR	80.00	174.00	1782.00	1557.00	910.00	173.00	75.00	
HYDROCARBON CONC.	PPM-C W	63750.00	10200.00	4500.00	1875.00	1200.00	12000.00	25000.00	
OXIDES OF NITROGEN CONC	PPM W	6.00	32.50	335.00	1225.00	1475.00	33.00	5.00	
CARBON MONOXIDE CONC.	PERCENT	5.85	7.00	8.00	4.05	2.65	7.10	6.25	
CARBON DIOXIDE CONC.	PERCENT	7.00	10.55	10.20	12.45	13.10	10.35	6.25	
OXYGEN CONC.	PERCENT	6.13	0.50	0.13	0.13	0.25	0.63	6.63	
WET CORRECTION FACTOR	--	0.90670	0.84063	0.84063	0.84063	0.84063	0.84063	0.91420	
PROP. TORQUE	FT-LB	10.00	30.00	501.00	490.00	261.00	30.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.00	11.90	28.70	27.70	18.00	12.00	16.00	
INDUCTION AIR TEMP	DEG F	91.00	90.00	96.00	96.00	93.00	93.00	94.00	
COOLING AIR TEMP	DEG F	109.00	109.00	106.00	106.00	105.00	109.00	110.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	2.10	2.10	2.10	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	251.00	280.00	453.00	460.00	403.00	333.00	286.00	
EXHAUST GAS TEMP	DEG F	395.00	675.00	1450.00	1400.00	1325.00	695.00	415.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10149	0.07874	0.07974	0.06975	0.06692	0.07920	0.10826	0.07647 TA
IND. F/A EQUIV. RATIO	--	1.52	1.18	1.19	1.04	1.00	1.18	1.62	1.14 TA
ENGINE OBSERVED POWER	HP	1.14	6.85	271.87	240.24	123.24	6.85	1.14	
OBS BMEP	PSI	2.90	8.70	145.29	142.10	75.69	8.70	2.90	
OBS BSFC	LBM/BHP-HR	7.003	1.569	0.515	0.445	0.487	1.969	7.003	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.77382	0.85590	3.92176	1.39917	0.52837	1.00086	1.10789	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.42802	0.12487	0.01443	0.00582	0.00429	0.14601	2.72044	
HC MASS / MODE	LB	0.04623	0.15692	0.01961	0.11660	0.05284	0.05004	0.05180	0.49403
HC MASS / RATED HP	LB/HP								0.00165
HC - PERCENT OF EPA STANDARD									86.67
CO EMISSION RATE	LB/HR	4.65910	5.96819	118.31844	51.28836	19.80128	10.04947	4.77984	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.07827	1.45425	0.43521	0.21349	0.16067	1.46411	4.18394	
CO MASS / MODE	LB	0.07765	1.82750	0.59159	4.27403	1.98013	0.50247	0.07966	9.33304
CO MASS / RATED HP	LB/HP								0.03111
CO - PERCENT OF EPA STANDARD									74.07
NOX EMISSION RATE	LB/HR	0.00087	0.00904	0.96810	3.03119	2.15354	0.00913	0.00069	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00076	0.00132	0.00356	0.01262	0.01747	0.00133	0.00060	
NOX MASS / MODE	LB	0.00001	0.00166	0.00484	0.25260	0.21535	0.00046	0.00001	0.47493
NOX MASS / RATED HP	LB/HP								0.00158
NOX- PERCENT OF EPA STANDARD									105.54
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09451	0.08589	0.08639	0.07576	0.07211	0.08684	0.10026	0.08196 TA
DIFF. CALC & MEAS F/A	PERCENT	-6.88	5.07	8.35	8.62	7.76	9.65	-7.38	7.18 TA
DIFF EV & CB RATE	PERCENT	0.05	1.60	1.48	1.64	1.35	1.62	0.05	
SUM OF MOLE FRACTIONS		1.03236	1.11010	1.10460	1.09038	1.07064	1.11050	1.02704	

IO-520-D S/N 559025 POST FLIGHT TEST - TEST 7C BASELINE RUNS 43-49 09/20/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.945	86.50	73.50	2.1250	86.50	300.00	520.00	3.000	5.550	1.454

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	43.	44.	45.	46.	47.	48.	49.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.50	117.00	68.00	16.80	6.70	
INDUCTION AIR FLOW (W)	LB/HR	84.50	191.20	1834.00	1488.00	881.00	190.00	88.00	
HYDROCARBON CONC.	PPM-C W	59250.00	27600.00	3975.00	1890.00	2100.00	36750.00	94000.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	16.00	240.00	230.00	240.00	11.00	8.00	
CARBON MONOXIDE CONC.	PERCENT	5.20	9.50	8.45	8.65	7.95	9.40	4.50	
CARBON DIOXIDE CONC.	PERCENT	7.70	6.15	10.00	9.65	10.35	7.60	8.00	
OXYGEN CONC.	PERCENT	5.75	1.63	0.13	0.13	0.13	2.50	5.75	
WET CORRECTION FACTOR	--	0.84089	0.84089	0.84089	0.84089	0.84089	0.84089	0.84089	
PROP. TORQUE	FT-LB	8.00	31.00	512.00	463.00	243.00	31.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.60	12.40	28.95	27.70	18.00	12.60	7.00	
INDUCTION AIR TEMP	DEG F	92.00	90.00	94.00	94.00	93.00	93.00	96.00	
COOLING AIR TEMP	DEG F	109.00	109.00	102.00	102.00	102.00	106.00	108.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	2.00	2.00	2.00	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	254.00	295.00	460.00	431.00	380.00	318.00	243.00	
EXHAUST GAS TEMP	DEG F	425.00	660.00	1400.00	1325.00	1210.00	670.00	420.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08406	0.08516	0.08161	0.07979	0.07832	0.08973	0.07726	0.08442 TA
IND. F/A EQUIV. RATIO	—	1.26	1.33	1.22	1.19	1.17	1.34	1.16	1.26 TA
ENGINE OBSERVED POWER	HP	0.91	7.08	277.86	227.00	114.74	7.08	0.91	
OBS BMEP	PSI	2.32	8.99	148.48	134.27	70.47	8.99	2.32	
OBS BSFC	LBM/BHP-HR	7.659	2.372	0.531	0.515	0.593	2.372	7.331	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.42437	2.58269	3.61256	1.37690	0.89755	3.36841	2.22934	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.65266	0.36463	0.01300	0.00607	0.00782	0.47556	2.43927	
HC MASS / MODE	LB	0.04041	0.47349	0.01806	0.11474	0.08976	0.16842	0.03716	0.94203
HC MASS / RATED HP	LB/HP								0.00314
HC - PERCENT OF EPA STANDARD									165.27
CO EMISSION RATE	LB/HR	3.61192	15.09079	130.36487	106.97470	57.68112	14.62581	3.15370	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.95204	2.13056	0.46921	0.47125	0.50269	2.06491	3.45068	
CO MASS / MODE	LB	0.06020	2.76664	0.65182	8.91455	5.76811	0.73129	0.05256	18.94516
CO MASS / RATED HP	LB/HP								0.06315
CO - PERCENT OF EPA STANDARD									150.36
NOX EMISSION RATE	LB/HR	0.00122	0.00496	0.72326	0.55561	0.34014	0.00334	0.00110	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00134	0.00070	0.00260	0.00245	0.00296	0.00047	0.00120	
NOX MASS / MODE	LB	0.00002	0.00091	0.00362	0.04630	0.03401	0.00017	0.00002	0.08505
NOX MASS / RATED HP	LB/HP								0.00028
NOX- PERCENT OF EPA STANDARD									18.90
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09380	0.09950	0.08717	0.08660	0.08478	0.10200	0.08928	0.09346 TA
DIFF. CALC & MEAS F/A	PERCENT	11.58	11.60	6.81	8.54	8.24	13.67	15.56	10.71 TA
DIFF EV & CB RATE	PERCENT	0.18	1.29	1.17	1.48	1.55	1.35	0.92	
SUM OF MOLE FRACTIONS		1.09340	1.11779	1.09833	1.10763	1.11147	1.12958	1.10951	

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10-520-D S/N 559025 POST FLIGHT TEST - TEST 8C BASELINE RUNS 50-56 09/20/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.945	86.50	73.50	2.1250	86.50	300.00	520.00	3.000	5.550	1.454

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	50.	51.	52.	53.	54.	55.	56.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.50	117.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	89.00	188.50	1836.00	1488.00	879.00	194.00	79.00	
HYDROCARBON CONC.	PPM-C W	52500.00	28500.00	3900.00	1770.00	2100.00	30750.00	57750.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	15.50	245.00	270.00	215.00	12.50	6.50	
CARBON MONOXIDE CONC.	PERCENT	4.40	9.05	8.40	8.25	8.30	9.80	4.75	
CARBON DIOXIDE CONC.	PERCENT	8.20	8.25	10.00	10.00	10.00	7.70	7.70	
OXYGEN CONC.	PERCENT	5.63	1.88	0.13	0.13	0.13	1.88	5.88	
WET CORRECTION FACTOR	--	0.84089	0.84089	0.84089	0.84089	0.84089	0.84089	0.87826	
PROP. TORQUE	FT-LB	10.00	30.00	508.00	468.00	240.00	31.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	16.00	12.40	28.95	27.70	18.00	12.60	15.90	
INDUCTION AIR TEMP	DEG F	95.00	92.00	95.00	95.00	94.00	95.00	96.00	
COOLING AIR TEMP	DEG F	107.00	107.00	102.00	102.00	102.00	107.00	108.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	2.00	2.00	2.00	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	240.00	273.00	458.00	433.00	383.00	308.00	274.00	
EXHAUST GAS TEMP	DEG F	425.00	650.00	1400.00	1335.00	1200.00	665.00	445.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07981	0.09044	0.08152	0.07979	0.07850	0.08788	0.08992	0.08508 TA
IND. F/A EQUIV. RATIO	--	1.19	1.35	1.22	1.19	1.17	1.31	1.35	1.27 TA
ENGINE OBSERVED POWER	HP	1.14	6.85	275.67	229.46	113.33	7.08	1.14	
OBS BMEP	PSI	2.90	8.70	147.32	135.72	69.60	8.99	2.90	
OBS BSFC	LBM/BHP-HR	6.127	2.451	0.535	0.510	0.600	2.372	6.127	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.27389	2.69823	3.55547	1.30793	0.89755	2.84691	2.37192	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.99041	0.39364	0.01290	0.00570	0.00792	0.40193	2.07622	
HC MASS / MODE	LB	0.03790	0.49468	0.01778	0.10899	0.08976	0.14235	0.03953	0.93098
HC MASS / RATED HP	LB/HP								0.00310
HC - PERCENT OF EPA STANDARD									163.33
CO EMISSION RATE	LB/HR	3.23509	14.54479	129.99826	103.48843	60.22052	15.40209	3.45900	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.83175	2.12192	0.47158	0.45102	0.53138	2.17451	3.02778	
CO MASS / MODE	LB	0.05392	2.66654	0.64999	8.62403	6.02205	0.77010	0.05765	18.84427
CO MASS / RATED HP	LB/HP								0.06281
CO - PERCENT OF EPA STANDARD									149.56
NOX EMISSION RATE	LB/HR	0.00129	0.00487	0.74064	0.66158	0.30471	0.00384	0.00089	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00113	0.00071	0.00269	0.00288	0.00269	0.00054	0.00077	
NOX MASS / MODE	LB	0.00002	0.00089	0.00370	0.05513	0.03047	0.00019	0.00001	0.09043
NOX MASS / RATED HP	LB/HP								0.00030
NOX- PERCENT OF EPA STANDARD									20.09

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08847	0.09795	0.08705	0.08562	0.08589	0.10183	0.09039	0.09272 TA
DIFF. CALC & MEAS F/A	PERCENT	10.85	8.30	6.77	7.30	9.41	15.88	0.53	8.98 TA
DIFF EV & CB RATE	PERCENT	0.09	0.61	1.15	1.22	1.66	1.87	0.05	
SUM OF MOLE FRACTIONS		1.08002	1.09418	1.09586	1.09218	1.10966	1.13882	1.04329	

IC-520-D S/N 559025 POST FLIGHT TEST - TEST 9C BASELINE RUNS 57-63 09/21/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.871	72.00	69.00	2.1250	72.00	300.00	520.00	3.000 5.550	1.428

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	57.	58.	59.	60.	61.	62.	63.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.50	117.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	91.00	196.00	1871.00	1527.00	899.00	194.00	86.00	
HYDROCARBON CONC.	PPM-C W	58500.00	22500.00	4050.00	1800.00	2040.00	34500.00	63000.00	
OXIDES OF NITROGEN CONC	PPM W	8.50	18.50	250.00	300.00	250.00	12.00	6.50	
CARBON MONOXIDE CONC.	PERCENT	4.70	9.15	8.10	7.80	7.65	9.50	5.35	
CARBON DIOXIDE CONC.	PERCENT	7.60	8.65	10.00	10.35	10.35	7.60	7.40	
OXYGEN CONC.	PERCENT	5.87	1.13	0.0	0.0	0.0	2.13	5.63	
WET CORRECTION FACTOR	--	0.84132	0.84132	0.84132	0.84132	0.84132	0.84132	0.84132	
PROP. TORQUE	FT-LB	10.00	30.00	521.00	477.00	248.00	30.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.90	12.40	28.92	27.70	18.00	12.50	16.00	
INDUCTION AIR TEMP	DEG F	79.00	77.00	83.00	83.00	81.00	80.00	81.00	
COOLING AIR TEMP	DEG F	93.00	93.00	91.00	90.00	89.00	93.00	95.00	
COOLING AIR DELTA P	IN H2O	0.60	0.60	1.80	1.80	1.80	0.60	0.60	
MAX CYL HEAD TEMP	DEG F	233.00	258.00	458.00	433.00	372.00	310.00	263.00	
EXHAUST GAS TEMP	DEG F	430.00	665.00	1410.00	1345.00	1210.00	655.00	420.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07804	0.08696	0.07998	0.07773	0.07674	0.08785	0.08257	0.08255 TA
IND. F/A EQUIV. RATIO	--	1.17	1.30	1.20	1.16	1.15	1.31	1.24	1.24 TA
ENGINE OBSERVED POWER	HP	1.14	6.85	282.72	233.87	117.11	6.85	1.14	
OBS BMEP	PSI	2.90	8.70	151.09	138.33	71.92	8.70	2.90	
OBS BSFC	LBM/BHP-HR	6.127	2.451	0.522	0.500	0.581	2.451	6.127	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.47853	2.15143	3.74641	1.33641	0.88614	3.18585	2.53929	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.16954	0.31387	0.01325	0.00571	0.00757	0.46478	2.22273	
HC MASS / MODE	LB	0.04131	0.39443	0.01873	0.11137	0.08861	0.15929	0.04232	0.85607
HC MASS / RATED HP	LB/HP								0.00285
HC - PERCENT OF EPA STANDARD									150.19
CO EMISSION RATE	LB/HR	3.38209	14.85567	127.26067	98.35799	56.43932	14.89971	3.66248	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.96045	2.16789	0.45013	0.42057	0.48195	2.17370	3.20589	
CO MASS / MODE	LB	0.05637	2.72431	0.63630	8.19650	5.64393	0.74499	0.06104	18.06342
CO MASS / RATED HP	LB/HP								0.06021
CO - PERCENT OF EPA STANDARD									143.36
NOX EMISSION RATE	LB/HR	0.00119	0.00587	0.76684	0.73858	0.36010	0.00367	0.00087	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00105	0.00086	0.00271	0.00316	0.00307	0.00054	0.00076	
NOX MASS / MODE	LB	0.00002	0.00108	0.00383	0.06155	0.03601	0.00018	0.00001	0.10269
NOX MASS / RATED HP	LB/HP								0.00034
NOX - PERCENT OF EPA STANDARD									22.82

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09233	0.09709	0.08711	0.08483	0.08470	0.10264	0.09732	0.09246 TA
DIFF. CALC & MEAS F/A	PERCENT	18.31	11.65	8.92	9.14	10.39	16.83	17.86	11.99 TA
DIFF EV & CB RATE	PERCENT	1.24	1.52	1.50	1.68	1.88	1.93	1.20	
SUM OF MOLE FRACTIONS		1.11534	1.11625	1.09298	1.10591	1.10835	1.13778	1.11776	

IO-520-D S/N 559025 AFTER TOP OVERHAUL TEST 10 BASELINE RUNS 1-7 12/21/76

PBARC	TCRY	TWEI	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.329	43.00	34.00	2.1250	43.00	300.00	520.00	3.000 5.550	0.254

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	147.50	117.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	80.00	185.00	1924.00	1561.00	897.00	184.00	75.00	
HYDROCARBON CONC.	PPM-C W	41250.00	15000.00	2325.00	1020.00	1500.00	22500.00	54000.00	
OXIDES OF NITROGEN CONC	PPM W	10.25	27.00	410.00	450.00	450.00	21.50	10.00	
CARBON MONOXIDE CONC.	PERCENT	4.05	5.00	6.90	6.85	6.40	9.60	4.45	
CARBON DIOXIDE CONC.	PERCENT	8.25	9.10	10.80	10.90	11.15	8.45	7.95	
OXYGEN CONC.	PERCENT	5.75	0.50	0.0	0.0	0.0	0.88	5.88	
WET CORRECTION FACTOR	--	0.93144	0.86042	0.86042	0.86042	0.86042	0.86042	0.92425	
PROP. TORQUE	FT-LB	10.00	33.00	544.00	504.00	257.00	33.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS DRY		15.50	12.60	28.90	27.70	18.00	13.00	15.50	
INDUCTION AIR TEMP	DEG F	53.00	50.00	55.00	55.00	53.00	53.00	55.00	
COOLING AIR TEMP	DEG F	61.00	63.00	60.00	61.00	60.00	64.00	65.00	
COOLING AIR DELTA P	IN H20	0.70	0.70	2.30	2.20	2.20	0.70	0.70	
MAX CYL HEAD TEMP	DEG F	195.00	251.00	458.00	438.00	362.00	295.00	240.00	
EXHAUST GAS TEMP	DEG F	880.00	1225.00	1500.00	1470.00	1465.00	1225.00	790.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08772	0.08511	0.07686	0.07514	0.07600	0.09154	0.09357	0.08392 TA
IND. F/A EQUIV. RATIO	--	1.31	1.33	1.15	1.12	1.14	1.37	1.40	1.26 TA
ENGINE OBSERVED POWER	HP	1.14	7.54	295.20	247.11	121.36	7.54	1.14	
CBS BMEP	PSI	2.90	9.57	157.76	146.16	74.53	9.57	2.90	
CBS BSFC	LBM/BHP-HR	6.127	2.228	0.500	0.473	0.560	2.228	6.127	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.81683	1.44705	2.17451	0.76102	0.65574	2.08428	2.19799	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.59033	0.19192	0.00737	0.00308	0.00540	0.27643	1.92397	
HC MASS / MODE	LB	0.03028	0.26529	0.01087	0.06342	0.06557	0.10421	0.03663	0.57628
HC MASS / RATED HP	LB/HP								0.00192
HC - PERCENT OF EPA STANDARD									101.10
CO EMISSION RATE	LB/HR	3.35420	15.08107	112.09416	88.77336	48.59750	15.44685	3.37961	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.93604	2.00014	0.37972	0.35925	0.40046	2.04866	2.95829	
CO MASS / MODE	LB	0.05590	2.76486	0.56047	7.39778	4.85975	0.77234	0.05633	16.46742
CO MASS / RATED HP	LB/HP								0.05489
CO - PERCENT OF EPA STANDARD									130.69
NOX EMISSION RATE	LB/HR	0.00150	0.00864	1.27154	1.11331	0.65232	0.00660	0.00135	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00131	0.00115	0.00431	0.00451	0.00538	0.00088	0.00118	
NOX MASS / MODE	LB	0.00002	0.00158	0.00636	0.09278	0.06523	0.00033	0.00002	0.16633
NOX MASS / RATED HP	LB/HP								0.00055
NOX- PERCENT OF EPA STANDARD									36.96
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07881	0.09416	0.08295	0.08204	0.08123	0.09913	0.08605	0.08866 TA
DIFF. CALC & MEAS F/A	PERCENT	-10.16	5.60	7.92	9.18	6.88	8.29	-8.04	5.65 TA
DIFF EV & CB RATE	PERCENT	0.05	0.80	1.67	1.95	1.52	1.06	0.05	
SUM OF MOLE FRACTIONS		0.99858	1.07607	1.09609	1.10968	1.09106	1.09224	1.01536	

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IO-520-D S/N 555025 AFTER TOP OVERHAUL TEST 2U BASELINE RUNS 8-14 01/04/77

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.113	48.00	45.00	2.1250	45.00	300.00	520.00	3.000	5.550	0.558

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.00	16.80	148.50	127.00	68.00	16.80	7.00	
INDUCTION AIR FLOW (W)	LB/HR	75.90	189.80	1938.00	1587.00	906.00	183.00	71.00	
HYDROCARBON CONC.	PPM-C W	56250.00	19500.00	2400.00	1020.00	1530.00	23550.00	61500.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	23.00	350.00	520.00	350.00	20.00	9.00	
CARBON MONOXIDE CONC.	PERCENT	4.15	9.05	7.25	6.20	6.90	9.10	4.80	
CARBON DIOXIDE CONC.	PERCENT	7.70	8.95	10.55	11.15	10.70	8.45	7.60	
OXYGEN CONC.	PERCENT	6.25	0.88	0.0	0.0	0.0	1.13	6.25	
WET CORRECTION FACTOR	--	0.92238	0.85551	0.85551	0.85551	0.85551	0.85551	0.92929	
PROP. TORQUE	FT-LB	10.00	37.00	550.00	507.00	255.00	35.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2850.00	2575.00	2480.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	15.60	12.80	28.90	27.70	18.00	12.80	16.00	
INDUCTION AIR TEMP	DEG F	53.00	49.00	55.00	55.00	54.00	54.00	55.00	
COOLING AIR TEMP	DEG F	65.00	66.00	59.00	58.00	59.00	64.00	66.00	
COOLING AIR DELTA P	IN H2O	0.70	0.70	2.40	2.40	2.40	0.70	0.70	
MAX CYL HEAD TEMP	DEG F	193.00	270.00	460.00	435.00	360.00	287.00	235.00	
EXHAUST GAS TEMP	DEG F	750.00	1250.00	1485.00	1480.00	1460.00	1215.00	700.00	
INDUCTION F/A RATIO (O)	LB/LB	0.09274	0.08501	0.07706	0.07414	0.07548	0.09232	0.09914	0.08405 TA
IND. F/A EQUIV. RATIO	--	1.39	1.33	1.15	1.11	1.13	1.38	1.48	1.26 TA
ENGINE OBSERVED POWER	HP	1.14	8.45	298.46	248.58	120.41	8.00	1.14	
OBS BMEP	PSI	2.90	10.73	159.50	147.03	73.95	10.15	2.90	
OBS BSFC	LBM/BHP-HR	6.127	1.587	0.498	0.471	0.565	2.101	6.127	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.33182	1.85128	2.25896	0.78288	0.67062	2.23320	2.38817	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.04112	0.21898	0.00757	0.00315	0.00557	0.27926	2.09045	
HC MASS / MODE	LB	0.03886	0.33940	0.01129	0.06524	0.06706	0.11166	0.03980	0.67332
HC MASS / RATED HP	LB/HP								0.00224
HC - PERCENT OF EPA STANDARD									118.13
CO EMISSION RATE	LB/HP	3.20344	14.83881	117.85513	82.18625	52.23357	14.90360	3.49680	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.80408	1.75526	0.39488	0.33063	0.43379	1.86366	3.06087	
CO MASS / MODE	LB	0.05339	2.72045	0.58928	6.84885	5.22336	0.74518	0.05828	16.23877
CO MASS / RATED HP	LB/HP								0.05413
CO - PERCENT OF EPA STANDARD									128.88
NOX EMISSION RATE	LB/HR	0.00124	0.00724	1.09238	1.32344	0.50870	0.00629	0.00116	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00108	0.00086	0.00366	0.00532	0.00422	0.00079	0.00101	
NOX MASS / MODE	LB	0.00002	0.00133	0.00546	0.11029	0.05087	0.00031	0.00002	0.16830
NOX MASS / RATED HP	LB/HP								0.00056
NOX - PERCENT OF EPA STANDARD									37.40
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08564	0.09547	0.08392	0.08063	0.08265	0.09789	0.08929	0.08948 TA
DIFF. CALC & MEAS F/A	PERCENT	-7.66	7.25	8.91	8.75	9.50	6.04	-9.94	6.46 TA
DIFF EV & CB RATE	PERCENT	0.05	0.99	1.77	1.78	1.87	0.45	0.05	
SUM OF MOLE FRACTIONS		1.00658	1.05536	1.09922	1.09402	1.09832	1.06504	1.02075	

APPENDIX E. TSIO-360-C TEST DATA

TSIO-360-C S/N 300244 TEST 1 BASELINE (20 DEG BTC) RUNS 1-7 07/01/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.094	87.00	77.00	2.1250	87.00	225.00	360.00	3.000 5.550	1.741

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	9.30	17.50	135.00	113.00	64.00	17.00	8.30	
INDUCTION AIR FLOW (W)	LB/HR	83.33	168.00	1356.00	1169.00	667.00	167.00	87.72	
HYDROCARBON CONC.	PPM-C W	100000.00	51000.00	1500.00	1600.00	1900.00	49000.00	100000.00	
OXIDES OF NITROGEN CONC	PPM W	27.50	37.50	95.00	90.00	100.00	40.00	27.50	
CARBON MONOXIDE CONC.	PERCENT	7.40	9.45	10.80	11.90	11.60	8.90	7.10	
CARBON DIOXIDE CONC.	PERCENT	5.40	6.50	7.85	7.85	8.20	7.20	4.80	
OXYGEN CONC.	PERCENT	5.00	3.75	0.0	0.0	0.0	3.60	8.50	
WET CORRECTION FACTOR	--	0.83739	0.86909	0.87643	0.85694	0.85607	0.86654	0.83615	
PROP. TORQUE	FT-LB	10.00	41.00	389.00	375.00	193.00	39.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
FIELD PRESSURE	IN HG ABS DRY	19.80	17.30	37.00	36.80	22.30	17.10	20.30	
INDUCTION AIR TEMP	DEG F	83.00	85.00	91.00	91.00	87.00	84.00	84.00	
COOLING AIR TEMP	DEG F	81.00	84.00	98.00	98.00	95.00	82.00	82.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	299.00	321.00	410.00	387.00	325.00	314.00	295.00	
EXHAUST GAS TEMP	DEG F	555.00	840.00	1470.00	1415.00	1275.00	830.00	510.00	
INDUCTION F/A RATIO (D)	LB/LB	0.11358	0.10601	0.10132	0.09838	0.09765	0.10360	0.09629	0.10238 TA
IND. F/A EQUIV. RATIO	--	1.70	1.59	1.52	1.47	1.46	1.55	1.44	1.53 TA
ENGINE OBSERVED POWER	HP	1.14	9.37	207.39	179.93	89.52	8.91	0.91	
OBS BMEP	PSI	4.19	17.17	162.95	157.08	80.85	16.34	3.35	
OBS BSFC	LBM/BHP-HR	8.141	1.868	0.651	0.628	0.715	1.908	9.082	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	4.40080	4.53153	1.20357	1.03754	0.69555	4.33225	4.07887	
BRAKE SPECIFIC HC	LBM/BHP-HR	3.85216	0.48373	0.00580	0.00577	0.00777	0.48617	4.46296	
HC MASS / MODE	LB	0.07335	0.83078	0.00602	0.08646	0.06955	0.21661	0.06798	1.35075
HC MASS / RATED HP	LB/HP								0.00600
HC - PERCENT OF EPA STANDARD									315.97
CO EMISSION RATE	LB/HR	5.50526	14.73180	153.32274	133.49564	73.38831	13.76516	4.88843	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.81894	1.57259	0.73931	0.74193	0.81982	1.54476	5.34875	
CO MASS / MODE	LB	0.09175	2.70083	0.76661	11.12463	7.33883	0.68826	0.08147	22.79237
CO MASS / RATED HP	LB/HP								0.10130
CO - PERCENT OF EPA STANDARD									241.19
NOX EMISSION RATE	LB/HR	0.00401	0.01105	0.25276	0.19352	0.12139	0.01173	0.00372	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00351	0.00118	0.00122	0.00108	0.00136	0.00132	0.00407	
NOX MASS / MODE	LB	0.00007	0.00203	0.00126	0.01613	0.01214	0.00059	0.00006	0.03227
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.56

** DATA VALIDITY CHECKS FOR ENG107 **

CAL. FUEL AIR RATIO	LB/LB	0.13356	0.10533	0.09472	0.09673	0.09547	0.10336	0.11485	0.10264 TA
DIFF. CALC & MEAS F/A	PERCENT	17.60	-0.64	-6.51	-1.67	-2.23	-0.23	19.27	0.25 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	0.41	
SUM OF MOLE FRACTIONS		1.03965	1.07824	0.98906	1.04449	1.05260	1.06985	1.15208	

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TSIO-360-C S/N 300244 TEST 2 BASELINE (20 DEG BTC) RUNS 8-14 07/24/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.024	79.00	77.00	2.1250	80.00	225.00	360.00	3.000 5.550	1.922

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.40	13.70	142.00	102.00	60.00	13.80	6.70	
INDUCTION AIR FLOW (W)	LB/HR	74.56	164.00	1408.00	1121.00	658.00	154.00	74.56	
HYDROCARBON CONC.	PPM-C W	84750.00	34500.00	1965.00	1770.00	2025.00	35250.00	87000.00	
OXIDES OF NITROGEN CONC	PPM W	7.50	27.00	47.50	95.00	92.00	26.00	8.50	
CARBON MONOXIDE CONC.	PERCENT	5.80	7.45	13.00	11.55	11.65	7.80	6.00	
CARBON DIOXIDE CONC.	PERCENT	5.50	6.55	7.00	8.10	8.10	8.40	5.50	
OXYGEN CONC.	PERCENT	8.00	2.87	0.0	0.0	0.0	2.75	8.12	
WET CORRECTION FACTOR	--	0.83316	0.83316	0.85991	0.83782	0.83706	0.84022	0.83811	
PROP. TORQUE	FT-LB	9.00	40.00	404.00	355.00	193.00	42.00	9.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2523.00	2430.00	1200.00	600.00	
FELD PRESSURE	IN HG ABS DRY	18.80	16.10	37.00	33.00	21.50	16.10	18.80	
INDUCTION AIR TEMP	DEG F	83.00	83.00	89.00	88.00	88.00	85.00	84.00	
COOLING AIR TEMP	DEG F	98.00	99.00	97.00	96.00	95.00	99.00	100.00	
COOLING AIR DELTA P	IN H20	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	253.00	322.00	443.00	425.00	354.00	348.00	291.00	
EXHAUST GAS TEMP	DEG F	575.00	885.00	1400.00	1375.00	1250.00	875.00	570.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08752	0.08517	0.10283	0.09277	0.09297	0.09137	0.09162	0.08948 TA
IND. F/A EQUIV. RATIO	--	1.31	1.27	1.54	1.39	1.39	1.37	1.37	1.34 TA
ENGINE OBSERVED POWER	HP	1.03	9.14	215.38	170.54	89.30	9.60	1.03	
CBS BMEP	PSI	3.77	16.76	169.23	148.71	80.85	17.59	3.77	
CBS BSFC	LBM/BHP-HR	6.225	1.499	0.659	0.598	0.672	1.438	6.516	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.91816	2.76148	1.57269	1.06371	0.71183	2.78307	3.11633	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.83818	0.30215	0.00730	0.00624	0.00797	0.29001	3.03092	
HC MASS / MODE	LB	0.04864	0.50627	0.00786	0.08864	0.07118	0.13915	0.05194	0.91369
HC MASS / RATED HP	LB/HP								0.00406
HC - PERCENT OF EPA STANDARD									213.73
CO EMISSION RATE	LB/HR	3.35902	10.02984	180.61890	117.40063	69.20184	10.44570	3.63634	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.26696	1.09743	0.83859	0.68841	0.77496	1.08851	3.53668	
CO MASS / MODE	LB	0.05598	1.83880	0.90309	9.78339	6.92018	0.52228	0.06061	20.08430
CO MASS / RATED HP	LB/HP								0.08926
CO - PERCENT OF EPA STANDARD									212.53
NOX EMISSION RATE	LB/HR	0.00086	0.00717	0.12606	0.18931	0.10724	0.00681	0.00101	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00083	0.00078	0.00059	0.00111	0.00120	0.00071	0.00098	
NOX MASS / MODE	LB	0.00001	0.00131	0.00063	0.01578	0.01072	0.00034	0.00002	0.02882
NOX MASS / RATED HP	LB/HP								0.00013
NOX- PERCENT OF EPA STANDARD									8.54

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.10354	0.09404	0.10141	0.09559	0.09591	0.09566	0.10540	0.09576 TA
DIFF. CALC & MEAS F/A	PERCENT	18.31	10.41	-1.38	3.04	3.16	4.69	15.05	7.02 TA
DIFF EV & CB RATE	PERCENT	0.62	0.80	0.05	0.05	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.14353	1.10604	1.03477	1.06050	1.06457	1.07341	1.11136	

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TSIO-360-C S/N 300244 TEST 3 BASELINE (20 DEG BTC) RUNS 15-21 07/24/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.012	84.00	78.00	2.1250	84.00	225.00	360.00	3.000	5.550	1.899

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.60	14.30	140.00	100.00	58.00	13.00	6.70	
INDUCTION AIR FLOW (W)	LB/HR	75.44	169.00	1369.00	1119.00	658.00	154.00	75.44	
HYDROCARBON CONC.	PPM-C W	78750.00	35250.00	1890.00	1710.00	1890.00	40500.00	87000.00	
OXIDES OF NITROGEN CONC	PPM W	9.25	27.50	55.00	95.00	120.00	25.00	10.25	
CARBON MONOXIDE CONC.	PERCENT	5.90	7.95	12.90	11.30	11.00	7.60	5.90	
CARBON DIOXIDE CONC.	PERCENT	6.00	8.30	7.00	8.00	8.30	7.90	5.50	
OXYGEN CONC.	PERCENT	7.37	2.75	0.13	0.13	0.13	2.75	8.12	
WET CORRECTION FACTOR	--	0.83354	0.83354	0.86743	0.83666	0.83385	0.83354	0.83419	
PROP. TORQUE	FT-LB	9.00	40.00	403.00	350.00	192.00	39.00	9.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
PFLD PRESSURE	IN HG ABS DRY	18.50	16.20	37.00	33.00	21.50	16.20	18.90	
INDUCTION AIR TEMP	DEG F	89.00	89.00	95.00	95.00	93.00	91.00	92.00	
COOLING AIR TEMP	DEG F	105.00	108.00	105.00	105.00	104.00	107.00	107.00	
COOLING AIR DELTA P	IN H20	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	275.00	340.00	447.00	430.00	360.00	340.00	285.00	
EXHAUST GAS TEMP	DEG F	600.00	900.00	1405.00	1385.00	1270.00	860.00	590.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08918	0.08425	0.10424	0.09110	0.08985	0.08605	0.09053	0.08837 TA
IND. F/A EQUIV. RATIO	--	1.33	1.29	1.56	1.36	1.34	1.29	1.35	1.32 TA
ENGINE OBSERVED POWER	HP	1.03	5.14	214.85	167.94	89.05	8.91	1.03	
CBS BMEP	PSI	3.77	16.76	168.81	146.61	80.43	16.34	3.77	
CBS BSFC	LBM/BHP-HR	6.419	1.565	0.652	0.595	0.651	1.459	6.516	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.86369	2.89514	1.48656	1.02736	0.66006	3.04179	3.13833	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.78521	0.31678	0.00692	0.00612	0.00741	0.34136	3.05232	
HC MASS / MODE	LB	0.04773	0.53078	0.00743	0.08561	0.06601	0.15209	0.05231	0.94195
HC MASS / RATED HP	LB/HP								0.00419
HC - PERCENT OF EPA STANDARD									220.34
CO EMISSION RATE	LB/HR	3.61028	10.98730	177.67670	114.66779	64.66777	9.60506	3.58412	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.51134	1.20219	0.82697	0.68281	0.72616	1.07790	3.48589	
CO MASS / MODE	LB	0.06017	2.01434	0.88838	9.55565	6.46678	0.48025	0.05974	19.52527
CO MASS / RATED HP	LB/HP								0.08678
CO - PERCENT OF EPA STANDARD									206.62
NOX EMISSION RATE	LB/HR	0.00112	0.00749	0.14345	0.18926	0.13897	0.00623	0.00123	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00108	0.00082	0.00067	0.00113	0.00156	0.00070	0.00119	
NOX MASS / MODE	LB	0.00002	0.00137	0.00072	0.01577	0.01390	0.00031	0.00002	0.03211
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.51
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10294	0.09626	0.10057	0.09482	0.09367	0.09979	0.10552	0.09645 TA
DIFF. CALC & MEAS F/A	PERCENT	15.43	11.60	-3.53	4.09	4.25	15.97	16.55	9.14 TA
DIFF EV & CB RATE	PERCENT	0.06	1.00	0.05	0.05	0.05	1.43	0.05	
SUM OF MOLE FRACTIONS		1.10375	1.11303	1.02977	1.05376	1.06106	1.09982	1.11196	

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TSIO-360-C S/N 300244 TEST 4 BASELINE (20 DEG BTC) RUNS 22-28 07/25/75

PBARC	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.012	86.00	79.00	2.1250	86.00	225.00	360.00	3.000 5.550	1.945

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	28.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.80	13.80	140.00	101.00	58.00	13.80	6.80	
INDUCTION AIR FLOW (W)	LB/HR	75.44	164.00	1401.00	1114.00	664.00	162.00	73.68	
HYDROCARBON CONC.	PPM-C W	80250.00	37500.00	1920.00	1740.00	1950.00	37500.00	88500.00	
OXIDES OF NITROGEN CONC	PPM W	11.87	29.00	52.50	95.00	95.00	27.00	11.25	
CARBON MONOXIDE CONC.	PERCENT	6.15	7.80	12.85	11.50	11.50	7.70	5.90	
CARBON DIOXIDE CONC.	PERCENT	6.05	8.15	7.10	8.00	8.00	8.15	5.50	
OXYGEN CONC.	PERCENT	7.50	3.13	0.13	0.13	0.13	3.13	8.25	
WET CORRECTION FACTOR	--	0.84152	0.83277	0.85985	0.83900	0.83277	0.83277	0.85001	
FROP. TORQUE	FT-LB	9.00	39.00	404.00	353.00	191.00	40.00	11.00	
FROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.90	16.20	37.00	33.00	21.50	16.10	18.70	
INDUCTION AIR TEMP	DEG F	86.00	87.00	94.00	93.00	92.00	90.00	90.00	
COOLING AIR TEMP	DEG F	102.00	105.00	105.00	105.00	105.00	107.00	110.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.10	3.10	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	282.00	331.00	449.00	440.00	355.00	344.00	299.00	
EXHAUST GAS TEMP	DEG F	625.00	880.00	1405.00	1380.00	1260.00	875.00	610.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09193	0.08582	0.10191	0.09246	0.08908	0.08688	0.09412	0.08857 TA
IND. F/A EQUIV. RATIO	--	1.38	1.28	1.52	1.38	1.33	1.30	1.41	1.33 TA
ENGINE OBSERVED POWER	HP	1.03	8.91	215.38	169.38	88.59	9.14	1.26	
OBS BMEP	PSI	3.77	16.34	169.23	147.87	80.01	16.76	4.61	
OBS BSFC	LBM/BHP-HR	6.614	1.549	0.650	0.596	0.655	1.510	5.411	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.92490	2.97877	1.51928	1.04205	0.67473	2.99341	3.18235	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.84474	0.33428	0.00705	0.00615	0.00762	0.32753	2.53238	
HC MASS / MODE	LB	0.04875	0.54611	0.00760	0.08684	0.06747	0.14967	0.05304	0.95947
HC MASS / RATED HP	LB/HP								0.00426
HC - PERCENT OF EPA STANDARD									224.44
CO EMISSION RATE	LB/HR	3.80798	10.41623	176.50203	116.65015	66.89633	10.33321	3.64056	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.70361	1.16893	0.81947	0.68871	0.75512	1.13062	2.89701	
CO MASS / MODE	LB	0.06347	1.90964	0.88251	9.72085	6.68963	0.51666	0.06068	19.84340
CO MASS / RATED HP	LB/HP								0.08819
CO - PERCENT OF EPA STANDARD									209.98
NOX EMISSION RATE	LB/HR	0.00143	0.00764	0.13775	0.18866	0.10900	0.00715	0.00134	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00140	0.00086	0.00064	0.00111	0.00123	0.00078	0.00107	
NOX MASS / MODE	LB	0.00002	0.00140	0.00069	0.01572	0.01090	0.00036	0.00002	0.02911
NOX MASS / RATED HP	LB/HP								0.00013
NOX- PERCENT OF EPA STANDARD									8.63
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10292	0.09603	0.10018	0.09518	0.09531	0.09588	0.10479	0.09632 TA
DIFF. CALC & MEAS F/A	PERCENT	11.96	11.90	-1.70	2.94	6.99	10.37	11.34	8.74 TA
DIFF EV & CB RATE	PERCENT	0.05	0.94	0.05	0.05	0.49	0.61	0.05	
SUM OF MOLE FRACTIONS		1.11186	1.11483	1.03944	1.05759	1.07789	1.05954	1.10288	

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TSIO-360-C S/N 300244 TEST 5A LEAN OUT RUNS 30.31.34.38.43 07/25/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.002	88.00	78.00	2.1250	88.00	225.00	360.00	3.000 5.550	1.808

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	30.	31.	34.	38.	43.	31.	30.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	5.90	12.60	135.00	95.00	55.00	12.60	5.90	
INDUCTION AIR FLOW (W)	LB/HR	68.42	157.00	1372.00	1085.00	674.00	157.00	68.42	
HYDROCARBON CONC.	PPM-C W	71250.00	30000.00	1800.00	1650.00	1650.00	30000.00	71250.00	
OXIDES OF NITROGEN CONC	PPM W	11.75	35.00	62.50	118.75	160.00	35.00	11.75	
CARBON MONOXIDE CONC.	PERCENT	5.45	7.30	12.45	10.95	10.05	7.30	5.45	
CARBON DIOXIDE CONC.	PERCENT	6.50	9.00	7.40	8.30	9.15	9.00	6.50	
OXYGEN CONC.	PERCENT	7.25	2.50	0.0	0.0	0.0	2.50	7.25	
WET CORRECTION FACTOR	--	0.84875	0.83504	0.85751	0.83504	0.83504	0.83504	0.84875	
PROP. TORQUE	FT-LB	11.00	41.00	399.00	341.00	193.00	41.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS	DRY	18.10	16.00	37.00	33.00	21.50	16.00	18.10	
INDUCTION AIR TEMP	DEG F	94.00	93.00	99.00	99.00	97.00	93.00	94.00	
COOLING AIR TEMP	DEG F	110.00	110.00	108.00	110.00	110.00	110.00	110.00	
COOLING AIR DELTA P.	IN H2O	0.50	0.50	3.50	2.40	2.50	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	247.00	337.00	453.00	470.00	382.00	337.00	247.00	
EXHAUST GAS TEMP	DEG F	575.00	910.00	1430.00	1400.00	1285.00	910.00	575.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08782	0.08173	0.10021	0.08917	0.08311	0.08173	0.08782	0.08405 TA
IND. F/A EQUIV. RATIO	--	1.31	1.22	1.50	1.33	1.24	1.22	1.31	1.26 TA
ENGINE OBSERVED POWER	HP	1.26	9.37	212.72	163.62	89.52	9.37	1.26	
OBS BMEP	PSI	4.61	17.17	167.14	142.84	80.85	17.17	4.61	
OBS BSFC	LBM/BHP-HR	4.695	1.345	0.635	0.581	0.614	1.345	4.695	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.38675	2.23101	1.38498	0.94633	0.54929	2.23101	2.38679	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.89931	0.23816	0.00651	0.00578	0.00614	0.23816	1.89931	
HC MASS / MODE	LB	0.03978	0.40902	0.00692	0.07886	0.05493	0.11155	0.03978	0.74084
HC MASS / RATED HP	LB/HP								0.00329
HC - PERCENT OF EPA STANDARD									173.30
CO EMISSION RATE	LB/HR	3.12819	9.15158	165.83247	105.86862	56.39957	9.15158	3.12819	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.48928	0.97691	0.77958	0.64705	0.63004	0.97691	2.48928	
CO MASS / MODE	LB	0.05214	1.67779	0.82916	8.82238	5.63995	0.45758	0.05214	17.53111
CO MASS / RATED HP	LB/HP								0.07792
CO - PERCENT OF EPA STANDARD									185.51
NOX EMISSION RATE	LB/HR	0.00131	0.00863	0.15946	0.22584	0.17662	0.00863	0.00131	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00104	0.00092	0.00075	0.00138	0.00197	0.00092	0.00104	
NOX MASS / MODE	LB	0.00002	0.00158	0.00080	0.01882	0.01766	0.00043	0.00002	0.03934
NOX MASS / RATED HP	LB/HP								0.00017
NOX- PERCENT OF EPA STANDARD									11.66

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09656	0.09192	0.09909	0.09400	0.09061	0.09192	0.09656	0.09243 TA
DIFF. CALC & MEAS F/A	PERCENT	9.95	12.46	-1.12	5.42	9.03	12.46	9.95	9.97 TA
DIFF EV & CB RATE	PERCENT	0.05	1.46	0.05	0.27	1.40	1.46	0.05	
SUM OF MOLE FRACTIONS		1.09183	1.12977	1.03949	1.06181	1.11219	1.12977	1.09183	

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TSIO-360-C S/N 300244 TEST 5B LEAN OUT RUNS 29,33,35,39,44 07/25/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.002	88.00	78.00	2.1250	88.00	225.00	360.00	3.000 5.590	1.808

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	33.	35.	39.	44.	33.	29.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.90	11.70	130.00	90.00	50.00	11.70	4.90	
INDUCTION AIR FLOW (W)	LB/HR	67.54	157.00	1367.00	1075.00	674.00	157.00	67.54	
HYDROCARBON CONC.	PPM-C W	54750.00	19200.00	1710.00	1500.00	1200.00	19200.00	54750.00	
OXIDES OF NITROGEN CONC	PPM W	20.00	47.00	75.00	198.00	600.00	47.00	20.00	
CARBON MONOXIDE CONC.	PERCENT	3.90	6.40	12.10	9.50	5.75	6.40	3.90	
CARBON DIOXIDE CONC.	PERCENT	7.45	10.05	7.75	9.30	11.20	10.05	7.45	
OXYGEN CONC.	PERCENT	7.00	1.50	0.0	0.0	0.0	1.50	7.00	
WET CORRECTION FACTOR	--	0.83504	0.83504	0.84914	0.83504	0.83504	0.83504	0.83504	
PROP. TORQUE	FT-LB	11.00	42.00	403.00	344.00	196.00	42.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
DELD PRESSURE	IN HG ABS DRY	18.00	16.20	37.00	33.00	21.50	16.20	18.00	
INDUCTION AIR TEMP	DEG F	93.00	94.00	100.00	100.00	97.00	94.00	93.00	
COOLING AIR TEMP	DEG F	109.00	111.00	107.00	109.00	110.00	111.00	109.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	4.00	2.80	2.50	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	279.00	360.00	435.00	459.00	405.00	360.00	279.00	
EXHAUST GAS TEMP	DEG F	645.00	960.00	1450.00	1435.00	1360.00	960.00	645.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07388	0.07589	0.09685	0.08526	0.07555	0.07589	0.07388	0.07762 TA
IND. F/A EQUIV. RATIO	--	1.11	1.14	1.45	1.28	1.13	1.14	1.11	1.16 TA
ENGINE OBSERVED POWER	HP	1.26	9.60	214.85	165.06	90.91	9.60	1.26	
OBS BMEP	PSI	4.61	17.59	168.81	144.10	82.10	17.59	4.61	
OBS BSFC	LBM/BHP-HR	3.899	1.219	0.605	0.545	0.550	1.219	3.899	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.75901	1.40671	1.28005	0.83512	0.41211	1.40671	1.75901	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.39975	0.14659	0.00596	0.00506	0.00453	0.14659	1.39975	
HC MASS / MODE	LB	0.02932	0.25790	0.00640	0.06959	0.04121	0.07034	0.02932	0.50407
HC MASS / RATED HP	LB/HP								0.00224
HC - PERCENT OF EPA STANDARD									117.91
CO EMISSION RATE	LB/HR	2.11224	7.90453	155.26714	89.16072	33.28870	7.90453	2.11224	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.68083	0.82370	0.72267	0.54018	0.36617	0.82370	1.68083	
CO MASS / MODE	LB	0.03520	1.44916	0.77634	7.43006	3.32887	0.39523	0.03520	13.45006
CO MASS / RATED HP	LB/HP								0.05978
CO - PERCENT OF EPA STANDARD									142.33
NOX EMISSION RATE	LB/HR	0.00213	0.01142	0.18616	0.36553	0.68327	0.01142	0.00213	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00170	0.00119	0.00087	0.00221	0.00752	0.00119	0.00170	
NOX MASS / MODE	LB	0.00004	0.00209	0.00093	0.03046	0.06833	0.00057	0.00004	0.10245
NOX MASS / RATED HP	LB/HP								0.00046
NOX- PERCENT OF EPA STANDARD									30.36

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08479	0.08677	0.09742	0.08930	0.07989	0.08677	0.08479	0.08569 TA
DIFF. CALC & MEAS F/A	PERCENT	14.77	14.33	0.59	4.73	5.74	14.33	14.77	10.40 TA
DIFF EV & CB RATE	PERCENT	0.29	2.14	0.05	0.47	0.79	2.14	0.29	
SUM OF MOLE FRACTIONS		1.09034	1.13116	1.05262	1.06910	1.04952	1.13116	1.09034	

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TSIO-360-C S/N 300244 TEST 5C LEAN OUT RUNS 29,32,36,40,45 07/25/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.002	88.00	78.00	2.1250	88.00	225.00	360.00	3.000	5.550	1.808

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	32.	36.	40.	45.	32.	29.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.90	10.60	125.00	85.00	45.00	10.60	4.90	
INDUCTION AIR FLOW (W)	LB/HR	67.54	157.00	1367.00	1075.00	674.00	157.00	67.54	
HYDROCARBON CONC.	PPM-C W	54750.00	8250.00	1500.00	1305.00	1088.00	8250.00	54750.00	
OXIDES OF NITROGEN CONC	PPM W	20.00	65.00	115.00	355.00	1000.00	65.00	20.00	
CARBON MONOXIDE CONC.	PERCENT	3.90	4.75	10.95	7.75	4.10	4.75	3.90	
CARBON DIOXIDE CONC.	PERCENT	7.45	11.20	8.30	10.30	12.05	11.20	7.45	
OXYGEN CONC.	PERCENT	7.00	1.00	0.0	0.0	0.13	1.00	7.00	
WET CORRECTION FACTOR	--	0.83504	0.83504	0.84632	0.83504	0.83504	0.83504	0.83504	
PROP. TORQUE	FT-LB	11.00	41.00	406.00	347.00	196.00	41.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2600.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.00	16.20	37.00	33.00	21.50	16.20	18.00	
INDUCTION AIR TEMP	DEG F	93.00	94.00	99.00	100.00	97.00	94.00	93.00	
COOLING AIR TEMP	DEG F	109.00	111.00	107.00	108.00	109.00	111.00	109.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	4.40	3.10	2.50	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	279.00	360.00	434.00	459.00	411.00	360.00	279.00	
EXHAUST GAS TEMP	DEG F	645.00	1040.00	1470.00	1470.00	1400.00	1040.00	645.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07388	0.06876	0.09313	0.08053	0.06800	0.06876	0.07388	0.07139 TA
IND. F/A EQUIV. RATIO	--	1.11	1.03	1.39	1.20	1.02	1.03	1.11	1.07 TA
ENGINE OBSERVED POWER	HP	1.26	5.37	216.55	166.50	90.91	9.37	1.26	
OBS BMEP	PSI	4.61	17.17	170.07	145.35	82.10	17.17	4.61	
OBS BSFC	LBM/BHP-HR	3.895	1.132	0.577	0.511	0.495	1.132	3.899	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.75901	0.60618	1.11805	0.71534	0.35309	0.60618	1.75901	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.39975	0.06471	0.00517	0.00430	0.00388	0.06471	1.39975	
HC MASS / MODE	LB	0.02932	0.11113	0.00559	0.05961	0.03531	0.03031	0.02932	0.30059
HC MASS / RATED HP	LB/HP								0.00134
HC - PERCENT OF EPA STANDARD									70.31
CO EMISSION RATE	LB/HR	2.11224	5.88346	139.44673	71.61345	22.42999	5.88346	2.11224	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.68083	0.62805	0.64424	0.43012	0.24673	0.62805	1.68083	
CO MASS / MODE	LB	0.03520	1.07863	0.69723	5.96778	2.24300	0.29417	0.03520	10.35123
CO MASS / RATED HP	LB/HP								0.04601
CO - PERCENT OF EPA STANDARD									109.54
NOX EMISSION RATE	LB/HR	0.00213	0.01584	0.28423	0.64526	1.07611	0.01584	0.00213	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00170	0.00169	0.00131	0.00388	0.01184	0.00169	0.00170	
NOX MASS / MODE	LB	0.00004	0.00290	0.00142	0.05377	0.10761	0.00079	0.00004	0.16657
NOX MASS / RATED HP	LB/HP								0.00074
NOX- PERCENT OF EPA STANDARD									49.35

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08479	0.07843	0.09390	0.08455	0.07568	0.07843	0.08479	0.07958 TA
DIFF. CALC & MEAS F/A	PERCENT	14.77	14.06	0.83	4.99	11.31	14.06	14.77	11.48 TA
DIFF EV & CB RATE	PERCENT	0.29	2.24	0.05	0.69	1.89	2.24	0.29	
SUM OF MOLE FRACTIONS		1.09034	1.11066	1.04394	1.06784	1.08101	1.11086	1.09034	

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TSIO-360-C S/N 300244 TEST 5D LEAN OUT RUNS 29.32.37.41.46 07/25/75

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.002	88.00	78.00	2.1250	88.00	225.00	360.00	3.000	5.550	1.808

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	32.	37.	41.	46.	32.	29.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.90	10.60	120.00	80.00	40.00	10.60	4.90	
INDUCTION AIR FLOW (W)	LB/HR	67.54	157.00	1367.00	1075.00	674.00	157.00	67.54	
HYDROCARBON CONC.	PPM-C W	54750.00	8250.00	1350.00	1125.00	505.00	8250.00	54750.00	
OXIDES OF NITROGEN CONC	PPM W	20.00	65.00	162.50	770.00	1863.00	65.00	20.00	
CARBON MONOXIDE CONC.	PERCENT	3.90	4.75	10.25	5.50	1.20	4.75	3.90	
CARBON DIOXIDE CONC.	PERCENT	7.45	11.20	9.00	11.50	12.75	11.20	7.45	
OXYGEN CONC.	PERCENT	7.00	1.00	0.0	0.0	0.63	1.00	7.00	
WET CORRECTION FACTOR	--	0.83504	0.83504	0.83810	0.83504	0.83504	0.83504	0.83504	
PROP. TORQUE	FT-LB	11.00	41.00	408.00	348.00	186.00	41.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS	DRY	18.00	16.20	37.00	33.00	21.50	16.20	18.00	
INDUCTION AIR TEMP	DEG F	93.00	94.00	100.00	100.00	97.00	94.00	93.00	
COOLING AIR TEMP	DEG F	109.00	111.00	106.00	108.00	109.00	111.00	109.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	4.80	3.60	2.50	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	279.00	360.00	436.00	456.00	409.00	360.00	279.00	
EXHAUST GAS TEMP	DEG F	645.00	1040.00	1495.00	1515.00	1440.00	1040.00	645.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07388	0.06876	0.08940	0.07579	0.06044	0.06876	0.07388	0.06882 TA
IND. F/A EQUIV. RATIO	--	1.11	1.03	1.34	1.13	0.90	1.03	1.11	1.03 TA
ENGINE OBSERVED POWER	HP	1.26	9.37	217.52	166.98	86.27	9.37	1.26	
OBS BMEP	PSI	4.61	17.17	170.91	145.77	77.91	17.17	4.61	
OBS BSFC	LBM/BHP-HR	3.895	1.132	0.552	0.479	0.464	1.132	3.899	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.75901	0.60618	0.97629	0.61069	0.13587	0.60618	1.75901	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.39975	0.06471	0.00449	0.00369	0.00157	0.06471	1.39975	
HC MASS / MODE	LB	0.02932	0.11113	0.00488	0.05139	0.01359	0.03031	0.02932	0.26993
HC MASS / RATED HP	LB/HP								0.00120
HC - PERCENT OF EPA STANDARD									63.14
CO EMISSION RATE	LB/HR	2.11224	5.88346	125.41534	50.82425	6.78664	5.88346	2.11224	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.68083	0.62805	0.57658	0.30438	0.07867	0.62805	1.68083	
CO MASS / MODE	LB	0.03520	1.07863	0.62708	4.23535	0.67866	0.29417	0.03520	6.98431
CO MASS / RATED HP	LB/HP								0.03104
CO - PERCENT OF EPA STANDARD									73.91
NOX EMISSION RATE	LB/HR	0.00213	0.01584	0.38968	1.39963	2.07252	0.01584	0.00213	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00170	0.00169	0.00179	0.00838	0.02402	0.00169	0.00170	
NOX MASS / MODE	LB	0.00004	0.00290	0.00195	0.11664	0.20725	0.00079	0.00004	0.32960
NOX MASS / RATED HP	LB/HP								0.00146
NOX- PERCENT OF EPA STANDARD									97.66
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08479	0.07843	0.09108	0.07911	0.06769	0.07843	0.08479	0.07680 TA
DIFF. CALC & MEAS F/A	PERCENT	14.77	14.06	1.88	4.38	12.00	14.06	14.77	11.59 TA
DIFF EV & CB RATE	PERCENT	0.29	2.24	0.05	0.60	1.35	2.24	0.29	
SUM OF MOLE FRACTIONS		1.09034	1.11086	1.06232	1.04986	1.02123	1.11086	1.09034	

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TSIO-360-C S/N 300244 TEST 5E LEAN OUT RUNS 29.32.37.42.46 07/25/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.002	88.00	78.00	2.1250	88.00	225.00	360.00	1.000	5.550	1.800

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	29.	32.	37.	42.	46.	32.	29.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.90	10.60	120.00	75.00	40.00	10.60	4.90	
INDUCTION AIR FLOW (W)	LB/HR	67.54	157.00	1367.00	1075.00	674.00	157.00	67.54	
HYDROCARBON CONC.	PPM-C W	54750.00	8250.00	1350.00	1020.00	405.00	8250.00	54750.00	
OXIDES OF NITROGEN CONC	PPM W	20.00	65.00	162.50	1688.00	1863.00	65.00	20.00	
CARBON MONOXIDE CONC.	PERCENT	3.90	4.75	10.25	3.60	1.20	4.75	3.90	
CARBON DIOXIDE CONC.	PERCENT	7.45	11.20	9.00	12.55	12.75	11.20	7.45	
OXYGEN CONC.	PERCENT	7.00	1.00	0.0	0.13	0.63	1.00	7.00	
WET CORRECTION FACTOR	--	0.83504	0.83504	0.83810	0.83504	0.83504	0.83504	0.83504	
PROP. TORQUE	FT-LB	11.00	41.00	408.00	346.00	186.00	41.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.00	16.20	37.00	33.00	21.50	16.20	18.00	
INDUCTION AIR TEMP	DEG F	93.00	94.00	100.00	100.00	97.00	94.00	93.00	
COOLING AIR TEMP	DEG F	109.00	111.00	106.00	107.00	109.00	111.00	109.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	4.80	3.60	2.50	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	279.00	360.00	436.00	461.00	409.00	360.00	279.00	
EXHAUST GAS TEMP	DEG F	645.00	1040.00	1495.00	1560.00	1440.00	1040.00	645.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07388	0.06876	0.08940	0.07105	0.06044	0.06876	0.07388	0.06795 TA
IND. F/A EQUIV. RATIO	--	1.11	1.03	1.34	1.06	0.90	1.03	1.11	1.02 TA
ENGINE OBSERVED POWER	HP	1.26	9.37	217.52	166.02	86.27	9.37	1.26	
OBS BMEP	PSI	4.61	17.17	170.91	144.94	77.91	17.17	4.61	
OBS BSFC	LBM/BHP-HR	3.899	1.132	0.552	0.452	0.464	1.132	3.899	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.75901	0.60618	0.97629	0.55197	0.13587	0.60618	1.75901	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.39975	0.06471	0.00449	0.00332	0.00157	0.06471	1.39975	
HC MASS / MODE	LB	0.02932	0.11113	0.00488	0.04600	0.01359	0.03031	0.02932	0.26454
HC MASS / RATED HP	LB/HP								0.00118
HC - PERCENT OF EPA STANDARD									61.08
CO EMISSION RATE	LB/HR	2.11224	5.88346	125.41534	32.84082	6.78664	5.88346	2.11224	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.68083	0.62805	0.57658	0.19782	0.07867	0.62805	1.68083	
CO MASS / MODE	LB	0.03520	1.07863	0.62708	2.73673	0.67866	0.29417	0.03520	5.48569
CO MASS / RATED HP	LB/HP								0.02438
CO - PERCENT OF EPA STANDARD									58.05
NOX EMISSION RATE	LB/HR	0.00213	0.01584	0.38968	3.02898	2.07252	0.01584	0.00213	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00170	0.00169	0.00179	0.01825	0.02402	0.00169	0.00170	
NOX MASS / MODE	LB	0.00004	0.00290	0.00195	0.25242	0.20725	0.00079	0.00004	0.46538
NOX MASS / RATED HP	LB/HP								0.00207
NOX- PERCENT OF EPA STANDARD									137.89
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08479	0.07843	0.09108	0.07443	0.06769	0.07843	0.08479	0.07594 TA
DIFF. CALC & MEAS F/A	PERCENT	14.77	14.06	1.88	4.75	12.00	14.06	14.77	11.76 TA
DIFF EV & CB RATE	PERCENT	0.29	2.24	0.05	0.64	1.35	2.24	0.29	
SUM OF MOLE FRACTIONS		1.09034	1.11086	1.06232	1.04648	1.02123	1.11086	1.09034	

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TSIO-360-C S/N 300244 TEST 6A 10 DEG BTC RUNS 47.50.54.59.64 07/28/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.923	81.00	76.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.789

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	47.	50.	54.	59.	64.	50.	47.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.30	14.90	135.00	97.00	55.00	14.90	7.30	
INDUCTION AIR FLOW (W)	LB/HR	80.70	177.00	1402.00	1087.00	587.00	177.00	80.70	
HYDROCARBON CONC.	PPM-C W	71250.00	20250.00	3225.00	1650.00	2130.00	20250.00	71250.00	
OXIDES OF NITROGEN CONC	PPM W	11.00	34.50	56.00	98.00	85.00	34.50	11.00	
CARBON MONOXIDE CONC.	PERCENT	6.40	8.40	12.60	11.05	11.15	8.40	6.40	
CARBON DIOXIDE CONC.	PERCENT	6.50	9.15	2.20	8.20	8.10	9.15	6.50	
OXYGEN CONC.	PERCENT	6.50	1.25	0.13	0.13	0.13	1.25	6.50	
WET CORRECTION FACTOR	--	0.84527	0.83536	0.84875	0.83920	0.85358	0.83536	0.84527	
PROP. TORQUE	FT-LB	10.00	41.00	373.00	324.00	168.00	41.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2335.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS DRY		19.50	17.20	37.00	33.00	21.50	17.20	19.50	
INDUCTION AIR TEMP	DEG F	88.00	89.00	96.00	96.00	96.00	89.00	88.00	
COOLING AIR TEMP	DEG F	101.00	107.00	107.00	110.00	112.00	107.00	101.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	2.60	1.90	1.40	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	275.00	340.00	453.00	460.00	407.00	340.00	275.00	
EXHAUST GAS TEMP	DEG F	695.00	1020.00	1505.00	1470.00	1330.00	1020.00	695.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09210	0.08571	0.09804	0.09086	0.09540	0.08571	0.09210	0.08939 TA
IND. F/A EQUIV. RATIO	--	1.38	1.28	1.47	1.36	1.43	1.28	1.38	1.34 TA
ENGINE OBSERVED POWER	HP	1.14	9.37	198.86	155.46	74.69	9.37	1.14	
OBS BMEP	PSI	4.19	17.17	156.25	135.72	70.37	17.17	4.19	
OBS BSFC	LBM/BHP-HR	6.390	1.591	0.679	0.624	0.736	1.591	6.390	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.82842	1.77287	2.49213	0.96152	0.69005	1.77287	2.82842	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.47581	0.18925	0.01253	0.00618	0.00924	0.18925	2.47581	
HC MASS / MODE	LB	0.04714	0.32503	0.01246	0.08013	0.06901	0.08864	0.04714	0.66954
HC MASS / RATED HP	LB/HP								0.00298
HC - PERCENT OF EPA STANDARD									156.62
CO EMISSION RATE	LB/HP	4.33534	12.40206	166.83194	109.09003	62.24556	12.40206	4.33534	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.79487	1.32389	0.83895	0.70172	0.83337	1.32389	3.79487	
CO MASS / MODE	LB	0.07226	2.27371	0.83416	9.09083	6.22455	0.62010	0.07226	19.18785
CO MASS / RATED HP	LB/HP								0.08528
CO - PERCENT OF EPA STANDARD									203.05
NOX EMISSION RATE	LB/HR	0.00145	0.01002	0.14349	0.18937	0.09131	0.01002	0.00145	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00127	0.00107	0.00072	0.00122	0.00122	0.00107	0.00127	
NOX MASS / MODE	LB	0.00002	0.00184	0.00072	0.01578	0.00913	0.00050	0.00002	0.02801
NOX MASS / RATED HP	LB/HP								0.00012
NOX - PERCENT OF EPA STANDARD									8.30
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10145	0.09310	0.10021	0.09385	0.09453	0.09310	0.10145	0.09424 TA
DIFF. CALC & MEAS F/A	PERCENT	10.15	8.62	2.21	3.29	-0.92	8.62	10.15	5.43 TA
DIFF EV & CB RATE	PERCENT	0.05	0.99	0.05	0.05	0.05	0.99	0.05	
SUM OF MOLE FRACTIONS		1.09711	1.10175	1.04864	1.05416	1.03951	1.10175	1.09711	

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TSIO-360-C S/N 3J0244 TEST 68 10 DEG BTC RUNS 48.51.55.60.65 07/28/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.923	81.00	76.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.789

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	48.	51.	55.	60.	65.	51.	48.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	5.30	13.80	130.00	90.00	50.00	13.80	5.30	
INDUCTION AIR FLOW (W)	LB/HR	78.95	177.00	1407.00	1087.00	592.00	177.00	78.95	
HYDROCARBON CONC.	PPM-C W	47250.00	13200.00	1590.00	1350.00	1590.00	13200.00	47250.00	
OXIDES OF NITROGEN CONC	PPM W	16.00	43.00	73.00	221.00	179.00	43.00	16.00	
CARBON MONOXIDE CONC.	PERCENT	4.10	7.45	11.90	8.80	8.95	7.45	4.10	
CARBON DIOXIDE CONC.	PERCENT	8.00	9.55	7.65	9.65	9.50	9.95	8.00	
OXYGEN CONC.	PERCENT	6.00	0.75	0.13	0.13	0.13	0.75	6.00	
WET CORRECTION FACTOR	--	0.83536	0.83536	0.84394	0.83536	0.83859	0.83536	0.83536	
FRCP. TORQUE	FT-LB	10.00	40.00	381.00	328.00	171.00	40.00	10.00	
FRCP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2350.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	19.30	17.20	37.00	33.00	21.50	17.20	19.30	
INDUCTION AIR TEMP	DEG F	88.00	89.00	96.00	97.00	96.00	89.00	88.00	
COOLING AIR TEMP	DEG F	106.00	107.00	105.00	108.00	113.00	107.00	106.00	
COOLING AIR DELTA P	IN H20	0.50	0.50	3.20	2.40	1.40	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	268.00	378.00	448.00	465.00	422.00	378.00	268.00	
EXHAUST GAS TEMP	DEG F	675.00	1060.00	1535.00	1525.00	1375.00	1060.00	675.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06835	0.07939	0.09408	0.08430	0.08600	0.07939	0.06835	0.08109 TA
IND. F/A EQUIV. RATIO	--	1.02	1.19	1.41	1.26	1.29	1.19	1.02	1.21 TA
ENGINE OBSERVED POWER	HP	1.14	9.14	203.12	157.38	76.51	9.14	1.14	
OBS BMEP	PSI	4.19	16.76	159.60	137.40	71.63	16.76	4.19	
OBS BSFC	LBM/BHP-HR	4.639	1.510	0.640	0.572	0.653	1.510	4.639	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.65524	1.12639	1.21653	0.76617	0.49864	1.12639	1.65524	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.44889	0.12325	0.00599	0.00487	0.00652	0.12325	1.44889	
HC MASS / MODE	LB	0.02759	0.20650	0.00608	0.06385	0.04986	0.05632	0.02759	0.43779
HC MASS / RATED HP	LB/HP								0.00195
HC - PERCENT OF EPA STANDARD									102.41
CO EMISSION RATE	LB/HR	2.42217	10.72089	155.12209	84.22411	47.51726	10.72089	2.42217	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.12020	1.17304	0.76369	0.53516	0.62103	1.17304	2.12020	
CO MASS / MODE	LB	0.04037	1.96550	0.77561	7.01867	4.75173	0.53604	0.04037	15.12829
CO MASS / RATED HP	LB/HP								0.06724
CO - PERCENT OF EPA STANDARD									160.09
NOX EMISSION RATE	LB/HR	0.00186	0.01217	0.18521	0.41590	0.18615	0.01217	0.00186	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00163	0.00133	0.00091	0.00264	0.00243	0.00133	0.00163	
NOX MASS / MODE	LB	0.00003	0.00223	0.00093	0.03466	0.01861	0.00061	0.00003	0.05710
NOX MASS / RATED HP	LB/HP								0.00025
NOX- PERCENT OF EPA STANDARD									16.92
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08403	0.08825	0.09671	0.08689	0.08753	0.08825	0.08403	0.08763 TA
DIFF. CALC & MEAS F/A	PERCENT	22.94	11.17	2.80	3.07	1.78	11.17	22.94	8.06 TA
DIFF EV & CB RATE	PERCENT	2.13	1.71	0.05	0.17	0.05	1.71	2.13	
SUM OF MOLE FRACTIONS		1.14965	1.11193	1.05106	1.05803	1.04871	1.11193	1.14965	

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E-12

TSIO-360-C S/N 300244 TEST 6C 10 DEG BTC RUNS 49.52.56.61.66 07/28/75

PBARO	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.923	81.00	76.00	2.1250	81.00	225.00	360.00	3.000 5.550	1.789

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	49.	52.	56.	61.	66.	52.	49.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.90	12.80	125.00	85.00	45.00	12.80	4.90	
INDUCTION AIR FLOW (W)	LB/HR	85.09	177.00	1397.00	1082.00	587.00	177.00	85.09	
HYDROCARBON CONC.	PPM-C W	42000.00	7800.00	1395.00	1215.00	1275.00	7800.00	42000.00	
OXIDES OF NITROGEN CONC	PPM W	23.00	50.00	119.00	370.00	500.00	50.00	23.00	
CARBON MONOXIDE CONC.	PERCENT	3.15	5.40	10.60	7.40	5.40	5.40	3.15	
CARBON DIOXIDE CONC.	PERCENT	8.20	11.00	8.55	10.35	11.30	11.00	8.20	
OXYGEN CONC.	PERCENT	6.62	0.62	0.13	0.13	0.13	0.62	6.62	
WET CORRECTION FACTOR	--	0.83536	0.83536	0.84412	0.83536	0.84053	0.83536	0.83536	
PROP. TORQUE	FT-LB	11.00	39.00	387.00	332.00	173.00	39.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2355.00	1200.00	600.00	
MELD PRESSURE	IN HG ABS DRY	20.00	17.20	37.00	33.00	21.50	17.20	20.00	
INDUCTION AIR TEMP	DEG F	88.00	89.00	95.00	97.00	6.00	89.00	88.00	
COOLING AIR TEMP	DEG F	107.00	107.00	103.00	108.00	113.90	107.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.60	2.70	1.40	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	255.00	385.00	450.00	465.00	440.00	385.00	255.00	
EXHAUST GAS TEMP	DEG F	700.00	1100.00	1560.00	1555.00	1440.00	1100.00	700.00	
INDUCTION F/A RATIO (D)	LB/LB	0.05863	0.07363	0.09111	0.07999	0.07806	0.07363	0.05863	0.07486 TA
IND. F/A EQUIV. RATIO	--	0.88	1.10	1.36	1.20	1.17	1.10	0.88	1.12 TA
ENGINE OBSERVED POWER	HP	1.26	8.91	206.32	159.30	77.57	8.91	1.26	
OBS BMEP	PSI	4.61	16.34	162.11	139.07	72.47	16.34	4.61	
OBS BSFC	LBM/BHP-HR	3.899	1.436	0.606	0.534	0.580	1.436	3.899	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.47477	0.67600	1.04855	0.67731	0.39713	0.67600	1.47477	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.17356	0.07586	0.00508	0.00425	0.00512	0.07586	1.17356	
HC MASS / MODE	LB	0.02458	0.12393	0.00524	0.05644	0.03971	0.03380	0.02458	0.30829
HC MASS / RATED HP	LB/HP								0.00137
HC - PERCENT OF EPA STANDARD									72.11
CO EMISSION RATE	LB/HR	1.86530	7.89236	135.77209	69.56702	28.54027	7.89236	1.86530	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.48432	0.88570	0.65806	0.43671	0.36791	0.88570	1.48432	
CO MASS / MODE	LB	0.03109	1.44693	0.67886	5.79725	2.85403	0.39462	0.03109	11.23386
CO MASS / RATED HP	LB/HP								0.04993
CO - PERCENT OF EPA STANDARD									118.88
NOX EMISSION RATE	LB/HR	0.00268	0.01437	0.29660	0.68394	0.51642	0.01437	0.00268	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00213	0.00161	0.00144	0.00429	0.00666	0.00161	0.00213	
NOX MASS / MODE	LB	0.00004	0.00263	0.00148	0.05700	0.05164	0.00072	0.00004	0.11356
NOX MASS / RATED HP	LB/HP								0.00050
NOX- PERCENT OF EPA STANDARD									33.65
** DATA VALIDITY CHECKS FOR ENGIO7 **									
CAL. FUEL AIR RATIO	LB/LB	0.07690	0.08089	0.09212	0.08334	0.07874	0.08089	0.07690	0.08070 TA
DIFF. CALC & MEAS F/A	PERCENT	31.15	9.85	1.11	4.19	0.88	9.85	31.15	7.79 TA
DIFF EV & CB RATE	PERCENT	3.42	1.48	0.05	0.46	0.05	1.48	3.42	
SUM OF MOLE FRACTIONS		1.20483	1.07875	1.05166	1.05588	1.01793	1.07876	1.20483	

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TSIO-360-C S/N 330244 TEST 6D 20 DEG BTC RUNS 49,53,57,62,67 07/28/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.923	81.00	76.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.789

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	49.	53.	57.	62.	67.	53.	49.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.50	11.80	120.00	80.00	30.00	11.80	4.90	
INDUCTION AIR FLOW (W)	LB/HR	85.09	177.00	1397.00	1087.00	577.00	177.00	85.09	
HYDROCARBON CONC.	PPM-C W	42000.00	3150.00	1260.00	1050.00	900.00	3150.00	42000.00	
OXIDES OF NITROGEN CONC	PPM W	23.00	77.00	188.00	725.00	870.00	77.00	23.00	
CARBON MONOXIDE CONC.	PERCENT	3.15	2.70	9.35	5.30	3.05	2.70	3.15	
CARBON DIOXIDE CONC.	PERCENT	8.20	11.75	9.40	11.30	12.60	11.75	8.20	
OXYGEN CONC.	PERCENT	6.62	1.87	0.13	0.13	0.13	1.87	6.62	
WET CORRECTION FACTOR	--	0.83536	0.84840	0.84102	0.83536	0.83536	0.84840	0.83536	
PROP. TORQUE	FT-LB	11.00	40.00	391.00	333.00	166.00	40.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2320.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	20.00	18.30	37.00	33.00	21.50	18.30	20.00	
INDUCTION AIR TEMP	DEG F	88.00	90.00	96.00	97.00	96.00	90.00	88.00	
COOLING AIR TEMP	DEG F	107.00	108.00	106.00	108.00	114.00	108.00	107.00	
COOLING AIR DELTA P	IN H20	0.50	0.50	4.00	3.00	1.40	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	255.00	390.00	450.00	466.00	450.00	390.00	255.00	
EXHAUST GAS TEMP	DEG F	700.00	1225.00	1595.00	1595.00	1480.00	1225.00	700.00	
INDUCTION F/A RATIO (D)	LB/LB	0.05863	0.06788	0.08746	0.07494	0.05294	0.06788	0.05863	0.06543 TA
IND. F/A EQUIV. RATIO	--	0.88	1.02	1.31	1.12	0.79	1.02	0.88	0.98 TA
ENGINE OBSERVED POWER	HP	1.26	9.14	208.65	159.78	73.33	9.14	1.26	
OBS BMEP	PSI	4.61	16.76	163.79	139.49	69.54	16.76	4.61	
OBS BSFC	LBM/BHP-HR	3.899	1.291	0.576	0.501	0.409	1.291	3.899	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.47477	0.28981	0.93260	0.58943	0.20110	0.28981	1.47477	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.17356	0.03171	0.00447	0.00369	0.00274	0.03171	1.17356	
HC MASS / MODE	LB	0.02458	0.05313	0.00466	0.04912	0.02011	0.01449	0.02458	0.19067
HC MASS / RATED HP	LB/HP								0.00085
HC - PERCENT OF EPA STANDARD									44.60
CO EMISSION RATE	LB/HR	1.86530	4.25457	117.49800	50.17378	11.49271	4.25457	1.86530	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.48432	0.46552	0.56366	0.31402	0.15673	0.46552	1.48432	
CO MASS / MODE	LB	0.03109	0.78000	0.58749	4.18115	1.14927	0.21273	0.03109	6.97282
CO MASS / RATED HP	LB/HP								0.03099
CO - PERCENT OF EPA STANDARD									73.79
NOX EMISSION RATE	LB/HR	0.00268	0.02349	0.46141	1.34953	0.64460	0.02349	0.00268	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00213	0.00257	0.00221	0.00845	0.00879	0.00257	0.00213	
NOX MASS / MODE	LB	0.00004	0.00431	0.00231	0.11246	0.06446	0.00117	0.00004	0.18480
NOX MASS / RATED HP	LB/HP								0.00082
NOX- PERCENT OF EPA STANDARD									54.75

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.07690	0.06850	0.08821	0.07844	0.07331	0.06850	0.07690	0.07221 TA
DIFF. CALC & MEAS F/A	PERCENT	31.15	0.91	0.86	4.67	38.48	0.91	31.15	10.37 TA
DIFF EV & CB RATE	PERCENT	3.42	0.05	0.05	0.49	6.42	0.05	3.42	
SUM OF MOLE FRACTIONS		1.20483	1.01189	1.05459	1.03439	1.26705	1.01189	1.20483	

TSIO-360-C S/N 300244 TEST 6E 10 DEG BTC RUNS 49,53,58,63,67 07/28/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.923	81.00	76.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.789

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	49.	53.	58.	63.	67.	53.	49.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.90	11.80	110.00	75.00	30.00	11.80	4.90	
INDUCTION AIR FLOW (W)	LB/HR	85.09	177.00	1387.00	1092.00	577.00	177.00	85.09	
HYDROCARBON CONC.	PPM-C W	42000.00	3150.00	1050.00	862.00	900.00	3150.00	42000.00	
OXIDES OF NITROGEN CONC	PPM W	23.00	77.00	440.00	1450.00	870.00	77.00	23.00	
CARBON MONOXIDE CONC.	PERCENT	3.15	2.70	7.10	3.15	3.05	2.70	3.15	
CARBON DIOXIDE CONC.	PERCENT	8.20	11.75	10.55	12.30	12.60	11.75	8.20	
OXYGEN CONC.	PERCENT	6.62	1.87	0.13	0.13	0.13	1.87	6.62	
WET CORRECTION FACTOR	--	0.83536	0.84840	0.83537	0.83536	0.83536	0.84840	0.83536	
PROP. TORQUE	FT-LB	11.00	40.00	395.00	330.00	166.00	40.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2320.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	20.00	18.30	37.00	33.00	21.50	18.30	20.00	
INDUCTION AIR TEMP	DEG F	88.00	90.00	98.00	98.00	96.00	90.00	88.00	
COOLING AIR TEMP	DEG F	107.00	108.00	106.00	108.00	114.00	108.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	4.50	3.00	1.40	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	255.00	390.00	456.00	467.00	450.00	390.00	255.00	
EXHAUST GAS TEMP	DEG F	700.00	1225.00	1650.00	1655.00	1480.00	1225.00	700.00	
INDUCTION F/A RATIO (D)	LB/LB	0.05863	0.06788	0.08075	0.06993	0.05294	0.06788	0.05863	0.06444 TA
IND. F/A EQUIV. RATIO	--	0.88	1.02	1.21	1.05	0.79	1.02	0.88	0.96 TA
ENGINE OBSERVED POWER	HP	1.26	9.14	210.59	158.34	73.33	9.14	1.26	
OBS BMEP	PSI	4.61	16.76	165.46	138.23	69.54	16.76	4.61	
OBS BSFC	LBM/BHP-HR	3.899	1.291	0.522	0.474	0.409	1.291	3.899	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.47477	0.28981	0.76258	0.48785	0.20110	0.28981	1.47477	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.17356	0.03171	0.00362	0.00308	0.00274	0.03171	1.17356	
HC MASS / MODE	LB	0.02458	0.05313	0.00381	0.04065	0.02011	0.01449	0.02458	0.18136
HC MASS / RATED HP	LB/HP								0.00081
HC - PERCENT OF EPA STANDARD									42.42
CO EMISSION RATE	LB/HR	1.86530	4.25457	86.96005	30.06407	11.49271	4.25457	1.86530	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.48432	0.46552	0.41294	0.18987	0.15673	0.46552	1.48432	
CO MASS / MODE	LB	0.03109	0.78000	0.43480	2.50534	1.14927	0.21273	0.03109	5.14432
CO MASS / RATED HP	LB/HP								0.02286
CO - PERCENT OF EPA STANDARD									54.44
NOX EMISSION RATE	LB/HR	0.00268	0.02349	1.05963	2.72114	0.64460	0.02349	0.00268	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00213	0.00257	0.00503	0.01719	0.00879	0.00257	0.00213	
NOX MASS / MODE	LB	0.00004	0.00431	0.00530	0.22676	0.06446	0.00117	0.00004	0.30209
NOX MASS / RATED HP	LB/HP								0.00134
NOX- PERCENT OF EPA STANDARD									89.51

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.07690	0.06850	0.08247	0.07363	0.07331	0.06850	0.07690	0.07127 TA
DIFF. CALC & MEAS F/A	PERCENT	31.15	0.91	2.12	5.28	38.48	0.91	31.15	10.60 TA
DIFF EV & CB RATE	PERCENT	3.42	0.05	0.05	0.44	6.42	0.05	3.42	
SUM OF MOLE FRACTIONS		1.20483	1.01189	1.04209	1.01221	1.26705	1.01189	1.20483	

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E-15

TSIO-360-C S/N [illegible] TEST 7A 25 DEG BTC RUNS 68,71,75,81,87 07/29/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.860	81.00	77.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.877

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	68.	71.	75.	81.	87.	71.	68.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.60	13.80	141.00	101.00	60.00	13.80	7.60	
INDUCTION AIR FLOW (W)	LB/HR	77.19	173.00	1400.00	1112.00	671.00	173.00	77.19	
HYDROCARBON CONC.	PPM-C W	96000.00	35250.00	1875.00	1725.00	2175.00	35250.00	96000.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	29.00	55.00	106.00	106.00	29.00	10.00	
CARBON MONOXIDE CONC.	PERCENT	6.40	7.95	12.75	11.25	11.30	7.95	6.40	
CARBON DIOXIDE CONC.	PERCENT	5.20	8.20	6.90	8.00	8.00	8.20	5.20	
OXYGEN CONC.	PERCENT	8.25	2.75	0.13	0.13	0.13	2.75	8.25	
WET CORRECTION FACTOR	--	0.85755	0.83391	0.86413	0.84269	0.83613	0.83391	0.85755	
FRCP. TORQUE	FT-LB	9.00	39.00	409.00	355.00	201.00	39.00	9.00	
FRCP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	19.10	16.10	37.00	33.00	31.50	16.10	19.10	
INDUCTION AIR TEMP	DEG F	86.00	88.00	94.00	94.00	93.00	88.00	86.00	
COOLING AIR TEMP	DEG F	101.00	107.00	98.00	98.00	97.00	107.00	101.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	6.70	6.70	6.70	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	258.00	308.00	413.00	368.00	303.00	308.00	258.00	
EXHAUST GAS TEMP	DEG F	565.00	865.00	1380.00	1345.00	1215.00	865.00	565.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10034	0.08129	0.10264	0.09256	0.09113	0.08129	0.10034	0.08715 TA
IND. F/A EQUIV. RATIO	--	1.50	1.22	1.54	1.38	1.36	1.22	1.50	1.30 TA
ENGINE OBSERVED POWER	HP	1.03	8.91	218.05	170.34	93.23	8.91	1.03	
OBS BMEP	PSI	3.77	16.34	171.33	148.71	84.20	16.34	3.77	
OBS BSFC	LBM/BHP-HR	7.392	1.549	0.647	0.593	0.644	1.549	7.392	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	3.65932	2.80664	1.50979	1.04190	0.78230	2.80664	3.65932	
BRAKE SPECIFIC HC	LBM/BHP-HR	3.55903	0.31497	0.00692	0.00612	0.00839	0.31497	3.55903	
HC MASS / MODE	LB	0.06099	0.51455	0.00755	0.08683	0.07823	0.14033	0.06099	0.94947
HC MASS / RATED HP	LB/HP								0.00422
HC - PERCENT OF EPA STANDARD									222.10
CO EMISSION RATE	LB/HR	4.22333	10.65613	179.09883	115.59639	68.60458	10.65613	4.22333	
BRAKE SPECIFIC CO	LBM/BHP-HR	4.10758	1.19585	0.82136	0.67864	0.73588	1.19585	4.10758	
CO MASS / MODE	LB	0.07039	1.95362	0.89549	9.63303	6.86046	0.53281	0.07039	20.01617
CO MASS / RATED HP	LB/HP								0.08896
CO - PERCENT OF EPA STANDARD									211.81
NOX EMISSION RATE	LB/HR	0.00126	0.00766	0.14685	0.21230	0.12642	0.00766	0.00126	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00123	0.00086	0.00067	0.00125	0.00136	0.00086	0.00123	
NOX MASS / MODE	LB	0.00002	0.00140	0.00073	0.01769	0.01264	0.00038	0.00002	0.03290
NOX MASS / RATED HP	LB/HP								0.00015
NOX- PERCENT OF EPA STANDARD									9.75

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.11016	0.09649	0.10063	0.09473	0.09509	0.09649	0.11016	0.09691 TA
DIFF. CALC & MEAS F/A	PERCENT	9.79	18.69	-1.96	2.34	4.35	18.69	9.79	11.20 TA
DIFF EV & CB RATE	PERCENT	0.05	2.27	0.05	0.05	0.05	2.27	0.05	
SUM OF MOLE FRACTIONS		1.10252	1.15568	1.02306	1.04686	1.05477	1.15568	1.10252	

TSIO-360-C S/N 300244 TEST 7B 25 DEG BTC RUNS 69,72,76,82,88 07/29/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.860	81.00	77.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.877

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	69.	72.	76.	82.	88.	72.	69.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	5.10	12.60	135.00	95.00	55.00	12.60	5.10	
INDUCTION AIR FLOW (W)	LB/HR	71.93	158.00	1397.00	1117.00	674.00	158.00	71.93	
HYDROCARBON CONC.	PPM-C W	54000.00	29250.00	1695.00	1655.00	1770.00	29250.00	54000.00	
OXIDES OF NITROGEN CONC	PPM W	19.00	36.50	72.00	185.00	285.00	36.50	19.00	
CARBON MONOXIDE CONC.	PERCENT	3.35	6.50	12.25	9.80	8.60	6.50	3.35	
CARBON DIOXIDE CONC.	PERCENT	7.30	9.15	7.30	8.95	9.65	9.15	7.30	
OXYGEN CONC.	PERCENT	7.25	2.25	0.13	0.13	0.13	2.25	7.25	
WET CORRECTION FACTOR	--	0.83646	0.83391	0.85506	0.83391	0.83391	0.83391	0.83646	
PROP. TORQUE	FT-LB	11.00	40.00	411.00	359.00	208.00	40.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
PFLD PRESSURE IN HG ABS DRY		18.50	15.90	37.00	33.00	21.50	15.90	18.50	
INDUCTION AIR TEMP	DEG F	87.00	88.00	95.00	95.00	93.00	88.00	87.00	
COOLING AIR TEMP	DEG F	105.00	106.00	98.00	98.00	97.00	106.00	105.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	6.70	6.70	6.70	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	241.00	346.00	419.00	380.00	310.00	346.00	241.00	
EXHAUST GAS TEMP	DEG F	560.00	900.00	1400.00	1380.00	1280.00	900.00	560.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07226	0.08127	0.09848	0.08668	0.08316	0.08127	0.07226	0.08221 TA
IND. F/A EQUIV. RATIO	--	1.08	1.22	1.47	1.30	1.24	1.22	1.08	1.23 TA
ENGINE OBSERVED POWER	HP	1.26	9.14	219.12	172.25	96.48	9.16	1.26	
OBS BMEP	PSI	4.61	16.76	172.16	150.38	87.13	16.76	4.61	
OBS BSFC	LBM/BHP-HR	4.058	1.379	0.616	0.552	0.570	1.379	4.058	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.88706	2.26176	1.32858	0.85822	0.61993	2.26176	1.88706	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.50164	0.24747	0.00606	0.00499	0.00643	0.24747	1.50164	
HC MASS / MODE	LB	0.03145	0.41466	0.00664	0.07156	0.06199	0.11309	0.03145	0.73084
HC MASS / RATED HP	LB/HP								0.00325
HC - PERCENT OF EPA STANDARD									170.96
CO EMISSION RATE	LB/HR	1.97682	8.46133	165.74364	97.36906	50.70744	8.46133	1.97682	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.57301	0.92581	0.75642	0.56526	0.52560	0.92581	1.57307	
CO MASS / MODE	LB	0.03295	1.55124	0.82872	8.11409	5.07074	0.42307	0.03295	16.05374
CO MASS / RATED HP	LB/HP								0.07135
CO - PERCENT OF EPA STANDARD									169.88
NOX EMISSION RATE	LB/HR	0.00220	0.00936	0.18714	0.36205	0.33099	0.00936	0.00220	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00175	0.00102	0.00085	0.00210	0.00343	0.00102	0.00175	
NOX MASS / MODE	LB	0.00004	0.00172	0.00094	0.03017	0.03310	0.00047	0.00004	0.06646
NOX MASS / RATED HP	LB/HP								0.00030
NOX- PERCENT OF EPA STANDARD									19.69
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.08260	0.09106	0.09839	0.08994	0.08678	0.09106	0.08260	0.08937 TA
DIFF. CALC & MEAS F/A	PERCENT	14.31	12.04	-0.10	3.77	4.35	12.04	14.31	8.72 TA
DIFF EV & CB RATE	PERCENT	0.05	1.18	0.05	0.09	0.36	1.18	0.05	
SUM OF MOLE FRACTIONS		1.06402	1.05014	1.03437	1.05457	1.05843	1.09014	1.06402	

E-16

TSIO-360-C S/N 300244 TEST 7C 25 DEG BTC RUNS 70,73,77,83,89 07/29/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3		PERCENT
29.860	81.00	77.00	2.1250	81.00	225.00	360.00	3.000 5.550	1.877

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	70.	73.	77.	83.	89.	73.	70.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.40	10.80	130.00	90.00	50.00	10.80	4.40	
INDUCTION AIR FLOW (W)	LB/HR	67.54	158.00	1392.00	1112.00	679.00	158.00	67.54	
HYDROCARBON CONC.	PPM-C W	46500.00	14250.00	1515.00	1230.00	1380.00	14250.00	46500.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	50.00	95.00	320.00	590.00	50.00	30.00	
CARBON MONOXIDE CONC.	PERCENT	2.30	5.60	11.50	8.25	6.30	5.60	2.30	
CARBON DIOXIDE CONC.	PERCENT	7.30	10.60	7.70	9.88	10.80	10.60	7.30	
OXYGEN CONC.	PERCENT	8.50	0.87	0.13	0.13	0.13	0.87	8.50	
WET CORRECTION FACTOR	--	0.86458	0.83391	0.85052	0.83391	0.83391	0.83391	0.86458	
PROP. TORQUE	FT-LB	10.00	40.00	412.00	361.00	208.00	40.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.00	15.50	37.00	33.00	21.50	15.50	18.00	
INDUCTION AIR TEMP	DEG F	89.00	88.00	95.00	94.00	93.00	88.00	89.00	
COOLING AIR TEMP	DEG F	107.00	106.00	99.00	100.00	97.00	106.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	6.70	6.70	6.70	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	220.00	355.00	427.00	388.00	315.00	355.00	220.00	
EXHAUST GAS TEMP	DEG F	540.00	975.00	1420.00	1425.00	1335.00	975.00	540.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06639	0.06966	0.09518	0.08248	0.07505	0.06966	0.06639	0.07323 TA
IND. F/A EQUIV. RATIO	--	0.99	1.04	1.42	1.23	1.12	1.04	0.99	1.10 TA
ENGINE OBSERVED POWER	HP	1.14	9.14	219.69	173.21	96.48	9.14	1.14	
CBS BMEP	PSI	4.19	16.76	172.58	151.22	87.13	16.76	4.19	
CBS BSFC	LBM/BHP-HR	3.851	1.182	0.592	0.520	0.518	1.182	3.851	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.54898	1.01033	1.17152	0.71207	0.46985	1.01033	1.54898	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.35587	0.11055	0.00533	0.00411	0.00487	0.11055	1.35587	
HC MASS / MODE	LB	0.02582	0.18523	0.00586	0.05934	0.04699	0.05052	0.02582	0.39956
HC MASS / RATED HP	LB/HP								0.00178
HC - PERCENT OF EPA STANDARD									93.46
CO EMISSION RATE	LB/HR	1.33725	6.68405	152.69498	80.40349	36.10995	6.68405	1.33725	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.17054	0.73135	0.69518	0.46419	0.37429	0.73135	1.17054	
CO MASS / MODE	LB	0.02229	1.22541	0.76347	6.70029	3.61100	0.33420	0.02229	12.67894
CO MASS / RATED HP	LB/HP								0.05635
CO - PERCENT OF EPA STANDARD									134.17
NOX EMISSION RATE	LB/HR	0.00331	0.01176	0.24360	0.61429	0.66610	0.01176	0.00331	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00290	0.00129	0.00111	0.00355	0.00690	0.00129	0.00290	
NOX MASS / MODE	LB	0.00006	0.00216	0.00122	0.05119	0.06661	0.00059	0.00006	0.12187
NOX MASS / RATED HP	LB/HP								0.00054
NOX- PERCENT OF EPA STANDARD									36.11

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.07098	0.08439	0.09582	0.08550	0.08093	0.08439	0.07098	0.08298 TA
DIFF. CALC & MEAS F/A	PERCENT	6.92	21.14	0.68	3.66	7.85	21.14	6.92	13.31 TA
DIFF EV & CB RATE	PERCENT	0.05	3.40	0.05	0.27	1.15	3.40	0.05	
SUM OF MOLE FRACTIONS		1.04896	1.15248	1.03318	1.05476	1.06559	1.15248	1.04896	

TSIO-360-C S/N 300244 TEST 7D 25 DEG BTC RUNS 70,74,78,84,90 07/29/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
29.860	81.00	77.00	2.1250	81.00	225.00	360.00	3.000	5.550	1.877

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	70.	74.	78.	84.	90.	74.	70.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.40	9.90	125.00	85.00	45.00	9.90	4.40	
INDUCTION AIR FLOW (W)	LB/HR	67.54	153.00	1368.00	1107.00	671.00	153.00	67.54	
HYDROCARBON CONC.	PPM-C W	46500.00	7875.00	1350.00	1155.00	1020.00	7875.00	46500.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	65.00	145.00	525.00	1612.00	65.00	30.00	
CARBON MONOXIDE CONC.	PERCENT	2.30	4.40	10.50	6.80	2.80	4.40	2.30	
CARBON DIOXIDE CONC.	PERCENT	7.30	11.40	4.55	10.60	12.50	11.40	7.30	
OXYGEN CONC.	PERCENT	8.50	0.75	0.13	0.13	0.13	0.75	8.50	
WET CORRECTION FACTOR	--	0.86458	0.83391	0.84659	0.83391	0.83391	0.83391	0.86458	
PROP. TORQUE	FT-LB	10.00	39.00	414.00	362.00	208.00	39.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.00	15.90	37.00	33.00	21.50	15.90	18.00	
INDUCTION AIR TEMP	DEG F	89.00	88.00	95.00	94.00	93.00	88.00	89.00	
COOLING AIR TEMP	DEG F	107.00	107.00	98.00	100.00	97.00	107.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	6.70	6.70	6.70	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	220.00	360.00	433.00	392.00	315.00	360.00	220.00	
EXHAUST GAS TEMP	DEG F	540.00	1025.00	1460.00	1465.00	1390.00	1025.00	540.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06639	0.06594	0.09178	0.07825	0.06835	0.06594	0.06639	0.06904 TA
IND. F/A EQUIV. RATIO	--	0.99	0.99	1.37	1.17	1.02	0.99	0.99	1.03 TA
ENGINE OBSERVED POWER	HP	1.14	8.91	220.72	173.69	96.48	8.91	1.14	
OBS BMEP	PSI	4.19	16.34	173.42	151.64	87.13	16.34	4.19	
OBS BSFC	LBM/BHP-HR	3.851	1.111	0.566	0.489	0.466	1.111	3.851	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.54898	0.54741	1.01734	0.65811	0.34991	0.54741	1.54898	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.35587	0.06143	0.00461	0.00379	0.00363	0.06143	1.35587	
HC MASS / MODE	LB	0.02582	0.10036	0.00509	0.05484	0.03499	0.02737	0.02582	0.27428
HC MASS / RATED HP	LB/HP								0.00122
HC - PERCENT OF EPA STANDARD									64.16
CO EMISSION RATE	LB/HR	1.33725	5.14890	135.23196	65.22746	16.17023	5.14890	1.33725	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.17054	0.57782	0.61270	0.37553	0.16761	0.57782	1.17054	
CO MASS / MODE	LB	0.02229	0.94397	0.67616	5.43562	1.61702	0.25745	0.02229	8.97479
CO MASS / RATED HP	LB/HP								0.03989
CO - PERCENT OF EPA STANDARD									94.97
NOX EMISSION RATE	LB/HR	0.00331	0.01498	0.36233	0.99194	1.83369	0.01498	0.00331	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00290	0.00168	0.00164	0.00571	0.01901	0.00168	0.00290	
NOX MASS / MODE	LB	0.00006	0.00275	0.00181	0.08266	0.18337	0.00075	0.00006	0.27145
NOX MASS / RATED HP	LB/HP								0.00121
NOX- PERCENT OF EPA STANDARD									80.43
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07098	0.07832	0.09192	0.08193	0.07295	0.07832	0.07098	0.07741 TA
DIFF. CALC & MEAS F/A	PERCENT	6.52	18.77	0.15	4.70	6.74	18.77	6.92	12.12 TA
DIFF EV & CB RATE	PERCENT	0.05	3.08	0.05	0.52	0.71	3.08	0.05	
SUM OF MOLE FRACTIONS		1.04896	1.13103	1.04508	1.05075	1.02020	1.13103	1.04896	

E-18

TSIO-360-C S/N 300244 TEST 7E 25 DEG BTC RUNS 70,74,79,85,90 07/29/75

PBARC	IDRY	IMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.860	81.00	77.00	2.1250	81.00	225.00	360.00	3.000 5.550	1.877

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	70.	74.	79.	85.	90.	74.	70.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.40	9.90	120.00	80.00	45.00	9.90	4.40	
INDUCTION AIR FLOW (W)	LB/HR	67.54	153.00	1377.00	1102.00	671.00	153.00	67.54	
HYDROCARBON CONC.	PPM-C W	46500.00	7875.00	1230.00	1005.00	1020.00	7875.00	46500.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	65.00	200.00	950.00	1612.00	65.00	30.00	
CARBON MONOXIDE CONC.	PERCENT	2.30	4.40	9.60	4.90	2.80	4.40	2.30	
CARBON DIOXIDE CONC.	PERCENT	7.30	11.40	8.95	11.50	12.50	11.40	7.30	
OXYGEN CONC.	PERCENT	8.50	0.75	0.13	0.13	0.13	0.75	8.50	
WET CORRECTION FACTOR	--	0.86458	0.83391	0.84402	0.83391	0.83391	0.83391	0.86458	
PROP. TORQUE	FT-LB	10.00	39.00	415.00	364.00	208.00	39.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE IN HG ABS DRY		18.00	15.90	37.00	33.00	21.50	15.90	18.00	
INDUCTION AIR TEMP	DEG F	89.00	88.00	95.00	94.00	93.00	88.00	89.00	
COOLING AIR TEMP	DEG F	107.00	107.00	99.00	100.00	97.00	107.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	6.70	6.70	6.70	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	220.00	360.00	445.00	395.00	315.00	360.00	220.00	
EXHAUST GAS TEMP	DEG F	540.00	1025.00	1485.00	1500.00	1390.00	1025.00	540.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06639	0.06594	0.08881	0.07398	0.06835	0.06594	0.06639	0.06823 TA
IND. F/A EQUIV. RATIO	--	0.99	0.99	1.33	1.11	1.02	0.99	0.99	1.02 TA
ENGINE OBSERVED POWER	HP	1.14	8.91	221.25	174.65	98.48	8.91	1.14	
CBS BMEP	PSI	4.19	16.34	173.84	152.48	87.13	16.34	4.19	
CBS BSFC	LBM/BHP-HR	3.851	1.111	0.542	0.458	0.466	1.111	3.851	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.54898	0.54741	0.91706	0.57217	0.34991	0.54741	1.54898	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.35587	0.06143	0.00414	0.00328	0.00363	0.06143	1.35587	
HC MASS / MODE	LB	0.02582	0.10036	0.00459	0.04768	0.03499	0.02737	0.02582	0.26662
HC MASS / RATED HP	LB/HP								0.00118
HC - PERCENT OF EPA STANDARD									62.37
CO EMISSION RATE	LB/HR	1.33725	5.14890	121.95659	46.96321	16.17023	5.14890	1.33725	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.17054	0.57782	0.55122	0.26889	0.16761	0.57782	1.17054	
CO MASS / MODE	LB	0.02229	0.94397	0.60978	3.91360	1.61702	0.25745	0.02229	7.38639
CO MASS / RATED HP	LB/HP								0.03283
CO - PERCENT OF EPA STANDARD									78.16
NOX EMISSION RATE	LB/HR	0.00331	0.01498	0.49446	1.79344	1.83369	0.01498	0.00331	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00290	0.00168	0.00223	0.01027	0.01901	0.00168	0.00290	
NOX MASS / MODE	LB	0.00006	0.00275	0.00247	0.14945	0.18337	0.00075	0.00006	0.33890
NOX MASS / RATED HP	LB/HP								0.00151
NOX- PERCENT OF EPA STANDARD									100.42
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07098	0.07832	0.08945	0.07751	0.07295	0.07832	0.07098	0.07658 TA
DIFF. CALC & MEAS F/A	PERCENT	6.92	18.77	0.72	4.77	6.74	18.77	6.92	12.24 TA
DIFF EV & CB RATE	PERCENT	0.05	3.08	0.05	0.46	0.71	3.08	0.05	
SUM OF MOLE FRACTIONS		1.04896	1.13103	1.03728	1.03092	1.02020	1.13103	1.04896	

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TSIO-360-C S/N 300244 TEST 7F 25 DEG BTC RUNS 70,74,80,86,90 07/29/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.860	81.00	77.00	2.1250	81.00	225.00	360.00	3.000 5.590	1.677

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	70.	74.	80.	86.	90.	74.	70.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	4.40	9.90	110.00	75.00	45.00	9.90	4.40	
INDUCTION AIR FLOW (W)	LB/HR	67.54	153.00	1367.00	1092.00	671.00	153.00	67.54	
HYDROCARBON CONC.	PPM-C W	46500.00	7875.00	1020.00	900.00	1020.00	7875.00	46500.00	
OXIDES OF NITROGEN CONC	PPM W	30.00	65.00	500.00	1675.00	1612.00	65.00	30.00	
CARBON MONOXIDE CONC.	PERCENT	2.30	4.40	7.10	3.35	2.80	4.40	2.30	
CARBON DIOXIDE CONC.	PERCENT	7.30	11.40	10.45	12.20	12.50	11.40	7.30	
OXYGEN CONC.	PERCENT	8.50	0.75	0.13	0.13	0.13	0.75	8.50	
WET CORRECTION FACTOR	--	0.86458	0.83391	0.84007	0.83391	0.83391	0.83391	0.86458	
FRCP. TORQUE	FT-LB	10.00	39.00	415.00	360.00	208.00	39.00	10.00	
FRCP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
FELD PRESSURE	IN HG ABS DRY	18.00	15.90	37.00	33.00	21.50	15.90	18.00	
INDUCTION AIR TEMP	DEG F	89.00	88.00	95.00	94.00	93.00	88.00	89.00	
COOLING AIR TEMP	DEG F	107.00	107.00	99.00	99.00	97.00	107.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	6.70	6.70	6.70	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	220.00	360.00	459.00	407.00	315.00	360.00	220.00	
EXHAUST GAS TEMP	DEG F	540.00	1025.00	1550.00	1530.00	1390.00	1025.00	540.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06639	0.06594	0.08201	0.06999	0.06835	0.06594	0.06639	0.06742 TA
IND. F/A EQUIV. RATIO	--	0.99	0.99	1.23	1.05	1.02	0.99	0.99	1.01 TA
ENGINE OBSERVED POWER	HP	1.14	8.91	221.25	172.73	96.48	8.91	1.14	
OBS BMEP	PSI	4.19	16.34	173.84	150.80	87.13	16.34	4.19	
OBS BSFC	LBM/BHP-HR	3.851	1.111	0.497	0.434	0.466	1.111	3.851	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.54898	0.54741	0.74100	0.50683	0.34991	0.54741	1.54898	
BRAKE SPECIFIC HC	LBM/BHP-HR	1.35587	0.06143	0.00335	0.00293	0.00363	0.06143	1.35587	
HC MASS / MODE	LB	0.02582	0.10036	0.00370	0.04224	0.03499	0.02737	0.02582	0.26029
HC MASS / RATED HP	LB/HP								0.00116
HC - PERCENT OF EPA STANDARD									60.89
CO EMISSION RATE	LB/HR	1.33725	5.14890	87.47316	31.75902	16.17023	5.14890	1.33725	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.17054	0.57782	0.39536	0.18386	0.16761	0.57782	1.17054	
CO MASS / MODE	LB	0.02229	0.94397	0.43737	2.64658	1.61702	0.25745	0.02229	5.94696
CO MASS / RATED HP	LB/HP								0.02643
CO - PERCENT OF EPA STANDARD									62.93
NOX EMISSION RATE	LB/HR	0.00331	0.01498	1.20446	3.12781	1.83369	0.01498	0.00331	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00290	0.00168	0.00544	0.01811	0.01901	0.00168	0.00290	
NOX MASS / MODE	LB	0.00006	0.00275	0.00602	0.26065	0.18337	0.00075	0.00006	0.45365
NOX MASS / RATED HP	LB/HP								0.00202
NOX- PERCENT OF EPA STANDARD									134.41
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07098	0.07632	0.08257	0.07408	0.07295	0.07832	0.07098	0.07587 TA
DIFF. CALC & MEAS F/A	PERCENT	6.92	18.77	0.68	5.84	6.74	18.77	6.92	12.53 TA
DIFF EV & CB RATE	PERCENT	0.05	3.08	0.05	0.53	0.71	3.08	0.05	
SUM OF MOLE FRACTIONS		1.04896	1.13103	1.03191	1.01796	1.02020	1.13103	1.04896	

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TSIO-360-C S/N 300244 TEST 8 IDLE/TAXI RPM VARIATIONS RUNS 91-96 07/29/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.820	85.00	78.00	2.1250	85.00	225.00	360.00	3.000 5.550	1.876

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 2	MODE 0
RUN NUMBER	--	91.	92.	93.	94.	95.	96.	
TIME IN MODE	MINUTES	1.00	1.00	1.00	11.00	11.00	11.00	
FUEL FLOW	LB/HR	6.50	8.40	10.80	13.70	16.60	22.00	
INDUCTION AIR FLOW (W)	LB/HR	76.32	108.00	137.00	167.00	200.00	250.00	
HYDROCARBON CONC.	PPM-C W	78000.00	51000.00	42000.00	32250.00	23200.00	13650.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	12.50	20.00	30.00	35.00	47.00	
CARBON MONOXIDE CONC.	PERCENT	6.40	7.30	7.10	8.00	9.10	10.40	
CARBON DIOXIDE CONC.	PERCENT	6.35	7.45	8.15	8.55	8.35	8.35	
OXYGEN CONC.	PERCENT	6.75	4.50	3.75	2.50	1.87	0.75	
WET CORRECTION FACTOR	--	0.83391	0.83391	0.83391	0.83391	0.83391	0.83391	
ENGP. TORQUE	FT-LB	10.00	18.00	27.00	40.00	53.00	74.00	
ENGP. SPEED	RPM	600.00	800.00	1000.00	1200.00	1400.00	1600.00	
MFLD PRESSURE	IN HG ABS DRY	19.00	17.30	16.20	16.20	16.30	16.70	
INDUCTION AIR TEMP	DEG F	90.00	90.00	90.00	91.00	92.00	92.00	
COOLING AIR TEMP	DEG F	104.00	105.00	106.00	107.00	107.00	107.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	0.50	0.50	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	270.00	289.00	323.00	347.00	362.00	383.00	
EXHAUST GAS TEMP	DEG F	650.00	700.00	780.00	900.00	945.00	1030.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08680	0.07526	0.08034	0.08360	0.08459	0.08968	
IND. F/A EQUIV. RATIO	--	1.30	1.19	1.20	1.25	1.27	1.34	
ENGINE OBSERVED POWER	HP	1.14	2.74	5.14	9.14	14.13	22.54	
OBS BMEP	PSI	4.19	7.54	11.31	16.76	22.20	31.00	
OBS BSFC	LBM/BHP-HR	5.690	3.064	2.101	1.499	1.175	0.976	
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	2.69671	2.41381	2.62877	2.54413	2.40236	1.73178	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.36052	0.88037	0.51135	0.27837	0.17004	0.07682	
HC MASS / MODE	LB	0.04495	0.04023	0.04381	0.46642	0.44043	0.31749	
CO EMISSION RATE	LB/HR	3.72502	5.81653	7.48119	10.62448	14.60450	22.21268	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.26063	2.12142	1.45523	1.16249	1.03373	0.98531	
CO MASS / MODE	LB	0.06208	0.09694	0.12469	1.94782	2.67749	4.07232	
NOX EMISSION RATE	LB/HR	0.00115	0.00196	0.00415	0.00785	0.01106	0.01977	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00100	0.00072	0.00081	0.00086	0.00078	0.00088	
NOX MASS / MODE	LB	0.00002	0.00003	0.00007	0.00144	0.00203	0.00362	
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.10509	0.09845	0.09478	0.09517	0.09607	0.09652	
DIFF. CALC & MEAS F/A	PERCENT	21.07	24.20	17.97	13.83	13.57	7.62	
DIFF EV & CB RATE	PERCENT	1.45	2.75	1.99	1.60	1.65	0.69	
SUM OF MOLE FRACTIONS		1.16404	1.15569	1.15791	1.13751	1.13710	1.09552	

TSIO-360-C S/N 300244 TEST 9A INDUCTION AIR PRESSURE VARIATIONS 07/30/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.863	80.00	78.00	2.1250	80.00	225.00	360.00	3.000	5.550	1.404

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	97.	101.	105.	108.	112.	101.	97.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.20	14.10	140.00	101.00	60.00	14.10	6.20	
INDUCTION AIR FLOW (W)	LB/HR	71.93	160.00	1360.00	1114.00	670.00	160.00	71.93	
HYDROCARBON CONC.	PPM-C W	84750.00	30750.00	2190.00	1950.00	2100.00	30750.00	84750.00	
OXIDES OF NITROGEN CONC	PPM W	9.37	31.00	41.25	76.25	93.75	31.00	9.37	
CARBON MONOXIDE CONC.	PERCENT	5.70	7.80	13.30	12.00	11.40	7.80	5.70	
CARBON DIOXIDE CONC.	PERCENT	6.50	8.75	6.65	7.65	8.00	8.75	6.50	
OXYGEN CONC.	PERCENT	7.00	2.37	0.13	0.13	0.13	2.37	7.00	
WET CORRECTION FACTOR	--	0.83204	0.83622	0.86375	0.83425	0.83477	0.83622	0.83204	
PROP. TORQUE	FT-LB	8.00	42.00	391.00	344.00	190.00	42.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.50	16.10	37.00	33.00	21.50	16.10	18.50	
INDUCTION AIR TEMP	DEG F	84.00	86.00	92.00	91.00	86.00	86.00	84.00	
COOLING AIR TEMP	DEG F	99.00	102.00	100.00	98.00	96.00	102.00	99.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	268.00	330.00	432.00	425.00	355.00	330.00	268.00	
EXHAUST GAS TEMP	DEG F	625.00	905.00	1360.00	1360.00	1260.00	905.00	625.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08794	0.08591	0.10457	0.09250	0.09137	0.08991	0.08794	0.09072 TA
IND. F/A EQUIV. RATIO	--	1.32	1.35	1.56	1.38	1.37	1.35	1.32	1.38 TA
ENGINE OBSERVED POWER	HP	0.91	9.60	208.59	165.06	88.13	[illegible]	0.91	
OBS BMEP	PSI	3.35	17.59	163.79	144.10	79.59	17.59	3.35	
OBS BSFC	LBM/BHP-HR	6.784	1.469	0.672	0.612	0.681	1.469	6.784	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.76581	2.51312	1.72253	1.16404	0.75304	2.51312	2.76581	
BRAKE SPECIFIC HC	LBM/BHP-HR	3.02626	0.26188	0.00826	0.00705	0.00854	0.26188	3.02626	
HC MASS / MODE	LB	0.04610	0.46074	0.00861	0.09700	0.07530	0.12566	0.04610	0.85951
HC MASS / RATED HP	LB/HP								0.00382
HC - PERCENT OF EPA STANDARD									201.05
CO EMISSION RATE	LB/HR	3.12456	10.76148	182.40938	120.64236	68.88971	10.76148	3.12456	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.41875	1.12141	0.87506	0.73091	0.78171	1.12141	3.41875	
CO MASS / MODE	LB	0.05208	1.97294	0.91205	10.05353	6.88897	0.53807	0.05208	20.46968
CO MASS / RATED HP	LB/HP								0.09098
CO - PERCENT OF EPA STANDARD									216.61
NOX EMISSION RATE	LB/HR	0.00101	0.00840	0.10759	0.15093	0.11147	0.00840	0.00101	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00111	0.00088	0.00052	0.00091	0.00126	0.00088	0.00111	
NOX MASS / MODE	LB	0.00002	0.00154	0.00054	0.01258	0.01115	0.00042	0.00002	0.02626
NOX MASS / RATED HP	LB/HP								0.00012
NOX- PERCENT OF EPA STANDARD									7.78
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10656	0.09411	0.10265	0.09711	0.09522	0.09411	0.10656	0.09591 TA
DIFF. CALC & MEAS F/A	PERCENT	21.17	4.67	-1.83	4.98	4.22	4.67	21.17	5.71 TA
DIFF EV & CB RATE	PERCENT	1.38	0.05	0.05	0.05	0.05	0.05	1.38	
SUM OF MOLE FRACTIONS		1.15893	1.07600	1.02841	1.06099	1.05785	1.07600	1.15893	

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TSIO-360-C S/N 300244 TEST 9B INDUCTION AIR PRESSURE VARIATIONS 07/30/75

PBARC	TCRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.863	80.00	78.00	2.1250	80.00	225.00	360.00	3.000 5.550	1.989

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	98.	102.	106.	109.	113.	102.	98.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.60	13.80	140.00	102.00	60.00	13.80	6.60	
INDUCTION AIR FLOW (W)	LB/HR	72.81	162.00	1361.00	1104.00	658.00	162.00	72.81	
HYDROCARBON CONC.	PPM-C W	78750.00	33750.00	2100.00	1860.00	2010.00	33750.00	78750.00	
OXIDES OF NITROGEN CONC	PPM W	9.62	30.00	42.50	85.00	97.50	30.00	9.62	
CARBON MONOXIDE CONC.	PERCENT	5.65	7.90	13.30	11.70	11.30	7.90	5.85	
CARBON DIOXIDE CONC.	PERCENT	6.50	8.85	7.10	7.80	8.20	8.85	6.50	
OXYGEN CONC.	PERCENT	7.00	2.60	0.13	0.13	0.13	2.60	7.00	
WET CORRECTION FACTOR	--	0.84065	0.83204	0.86474	0.84318	0.84139	0.83204	0.84065	
PROP. TORQUE	FT-LB	9.00	40.00	395.00	348.00	199.00	40.00	9.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.60	16.10	37.00	33.00	21.50	16.10	18.60	
INDUCTION AIR TEMP	DEG F	84.00	85.00	93.00	91.00	87.00	85.00	84.00	
COOLING AIR TEMP	DEG F	100.00	102.00	100.00	98.00	95.00	102.00	100.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	258.00	340.00	440.00	428.00	351.00	340.00	258.00	
EXHAUST GAS TEMP	DEG F	695.00	900.00	1380.00	1380.00	770.00	900.00	695.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09249	0.08691	0.10495	0.09427	0.09304	0.08691	0.09249	0.09021 TA
IND. F/A EQUIV. RATIO	--	1.38	1.30	1.57	1.41	1.39	1.30	1.38	1.35 TA
ENGINE OBSERVED POWER	HP	1.03	9.14	210.59	166.98	92.30	9.14	1.03	
OBS BMEP	PSI	3.77	16.76	165.46	145.77	83.36	16.76	3.77	
OBS BSFC	LBM/BHP-HR	6.419	1.510	0.665	0.611	0.650	1.510	6.419	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.79108	2.63768	1.61474	1.11861	0.71193	2.63768	2.79108	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.71459	0.28861	0.00767	0.00670	0.00771	0.28861	2.71459	
HC MASS / MODE	LB	0.04652	0.48358	0.00807	0.09322	0.07119	0.13188	0.04652	0.88098
HC MASS / RATED HP	LB/HP								0.00392
HC - PERCENT OF EPA STANDARD									206.08
CO EMISSION RATE	LB/HR	3.51869	10.37067	178.52745	119.77365	67.98328	10.37067	3.51869	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.42225	1.13472	0.84776	0.71731	0.73654	1.13472	3.42225	
CO MASS / MODE	LB	0.05864	1.90129	0.89264	9.98114	6.79833	0.51853	0.05864	20.20918
CO MASS / RATED HP	LB/HP								0.08982
CO - PERCENT OF EPA STANDARD									213.85
NOX EMISSION RATE	LB/HR	0.00113	0.00777	0.10836	0.16951	0.11451	0.00777	0.00113	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00110	0.00085	0.00051	0.00102	0.00124	0.00085	0.00110	
NOX MASS / MODE	LB	0.00002	0.00143	0.00054	0.01413	0.01145	0.00039	0.00002	0.02797
NOX MASS / RATED HP	LB/HP								0.00012
NOX- PERCENT OF EPA STANDARD									8.29
** DATA VALIDITY CHECKS FOR ENGIOT **									
CAL. FUEL AIR RATIO	LB/LB	0.10285	0.09481	0.10105	0.09611	0.09449	0.09481	0.10285	0.09564 TA
DIFF. CALC & MEAS F/A	PERCENT	11.20	9.09	-3.71	1.96	1.56	9.09	11.20	6.01 TA
DIFF EV & CB RATE	PERCENT	0.05	0.84	0.05	0.05	0.05	0.84	0.05	
SUM OF MOLE FRACTIONS		1.10360	1.12570	1.04966	1.05020	1.05807	1.12570	1.10360	

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TSIO-360-C S/N 300244 TEST 9C INDUCTION AIR PRESSURE VARIATIONS 07/30/75

PBARO	TDRY	THET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED HP	CID	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3		
29.863	80.00	78.00	2.1250	80.00	225.00	360.00	3.000 5.550	1.989

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	—	99.	103.	107.	110.	114.	103.	99.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.10	13.80	140.00	101.00	60.00	13.80	7.10	
INDUCTION AIR FLOW (W)	LB/HR	74.56	166.00	1367.00	1114.00	686.00	166.00	74.56	
HYDROCARBON CONC.	PPM-C W	92250.00	41250.00	2025.00	1845.00	1920.00	41250.00	92250.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	26.00	51.25	100.00	102.50	26.00	9.00	
CARBON MONOXIDE CONC.	PERCENT	6.20	7.80	12.85	11.30	11.15	7.80	6.20	
CARBON DIOXIDE CONC.	PERCENT	5.80	8.00	7.05	8.00	8.20	8.00	5.80	
OXYGEN CONC.	PERCENT	7.75	3.25	0.13	0.13	0.13	3.25	7.75	
WET CORRECTION FACTOR	--	0.84144	0.83204	0.86725	0.84036	0.83204	0.83204	0.84144	
PROP. TORQUE	FT-LB	10.00	39.00	407.00	356.00	201.00	39.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	18.80	16.10	37.00	33.00	21.50	16.10	18.80	
INDUCTION AIR TEMP	DEG F	85.00	87.00	93.00	92.00	90.00	87.00	85.00	
COOLING AIR TEMP	DEG F	102.00	102.00	100.00	98.00	96.00	102.00	102.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	257.00	340.00	446.00	434.00	353.00	340.00	257.00	
EXHAUST GAS TEMP	DEG F	625.00	875.00	1405.00	1385.00	1270.00	875.00	625.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09716	0.08482	0.10449	0.09250	0.08924	0.08482	0.09716	0.08832 TA
IND. F/A EQUIV. RATIO	—	1.45	1.27	1.56	1.38	1.34	1.27	1.45	1.32 TA
ENGINE OBSERVED POWER	HP	1.14	8.91	216.98	170.81	93.23	8.91	1.14	
OBS BMEP	PSI	4.19	16.34	170.49	149.12	84.20	16.34	4.19	
OBS BSFC	LBM/BHP-HR	6.215	1.549	0.645	0.591	0.644	1.549	6.215	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	3.32333	3.23138	1.59184	1.11376	0.69325	3.23138	3.32333	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.90903	0.36263	0.00734	0.00652	0.00744	0.36263	2.90903	
HC MASS / MODE	LB	0.05539	0.59242	0.00796	0.09281	0.06932	0.16157	0.05539	1.03486
HC MASS / RATED HP	LB/HP								0.00460
HC - PERCENT OF EPA STANDARD									242.07
CO EMISSION RATE	LB/HR	3.79412	10.26336	176.85077	119.72441	67.62262	10.26336	3.79412	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.32112	1.15178	0.81504	0.67748	0.72534	1.15178	3.32112	
CO MASS / MODE	LB	0.06324	1.88162	0.88425	9.64370	6.76226	0.51317	0.06324	19.81143
CO MASS / RATED HP	LB/HP								0.08805
CO - PERCENT OF EPA STANDARD									209.64
NOX EMISSION RATE	LB/HR	0.00108	0.00675	0.13359	0.20017	0.12272	0.00675	0.00108	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00094	0.00076	0.00062	0.00117	0.00132	0.00076	0.00094	
NOX MASS / MODE	LB	0.00002	0.00124	0.00067	0.01668	0.01227	0.00034	0.00002	0.03123
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.25
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10931	0.09797	0.10040	0.09489	0.09419	0.09797	0.10931	0.09743 TA
DIFF. CALC & MEAS F/A	PERCENT	12.51	15.50	-3.92	2.58	5.55	15.50	12.51	10.32 TA
DIFF EV & CB RATE	PERCENT	0.05	1.54	0.05	0.05	0.24	1.54	0.05	
SUM OF MOLE FRACTIONS		1.11642	1.13619	1.02577	1.04935	1.06798	1.13619	1.11642	

TSIO-360-C S/N 300244 TEST 9D INDUCTION AIR PRESSURE VARIATIONS 07/30/75

PBARC	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.863	80.00	78.00	2.1250	80.00	225.00	360.00	3.000	5.550	1.989

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	100.	104.	107.	111.	115.	104.	100.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.50	14.00	140.00	101.00	60.00	14.00	7.50	
INDUCTION AIR FLOW (W)	LB/HR	76.32	168.00	1367.00	1114.00	702.00	168.00	76.32	
HYDROCARBON CONC.	PPM-C W	94500.00	42000.00	2025.00	1800.00	1875.00	42000.00	94500.00	
OXIDES OF NITROGEN CONC	PPM W	9.37	23.50	51.25	105.00	106.25	23.50	9.37	
CARBON MONOXIDE CONC.	PERCENT	6.40	8.25	12.85	11.15	11.05	8.25	6.40	
CARBON DIOXIDE CONC.	PERCENT	5.50	7.70	1.05	8.20	8.30	7.70	5.50	
OXYGEN CONC.	PERCENT	7.87	3.25	0.13	0.13	0.13	3.25	7.87	
WET CORRECTION FACTOR	--	0.85130	0.83204	0.86725	0.84139	0.83204	0.83204	0.85130	
PROP. TORQUE	FT-LB	11.00	40.00	407.00	358.00	202.00	40.00	11.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	19.00	16.10	37.00	33.00	21.50	16.10	19.00	
INDUCTION AIR TEMP	DEG F	86.00	87.00	93.00	91.00	90.00	87.00	86.00	
COOLING AIR TEMP	DEG F	102.00	103.00	100.00	98.00	96.00	103.00	102.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	254.00	340.00	446.00	435.00	353.00	340.00	254.00	
EXHAUST GAS TEMP	DEG F	600.00	860.00	1405.00	1390.00	1270.00	860.00	600.00	
INDUCTION F/A RATIO (D)	LB/LB	0.10027	0.08502	0.10449	0.09250	0.08720	0.08502	0.10027	0.08820 TA
IND. F/A EQUIV. RATIO	--	1.50	1.27	1.56	1.38	1.30	1.27	1.50	1.32 TA
ENGINE OBSERVED POWER	HP	1.26	9.14	216.98	171.77	93.69	9.14	1.26	
OBS BMEP	PSI	4.61	16.76	170.49	149.96	84.62	16.76	4.61	
OBS BSFC	LBM/BHP-HR	5.968	1.532	0.645	0.588	0.640	1.532	5.968	

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CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	3.54877	3.29965	1.59184	1.08281	0.67719	3.29965	3.54877	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.82396	0.36104	0.00734	0.00630	0.00723	0.36104	2.82396	
HC MASS / MODE	LB	0.05915	0.60493	0.00796	0.09023	0.06772	0.16498	0.05915	1.05412
HC MASS / RATED HP	LB/HP								0.00468
HC - PERCENT OF EPA STANDARD									246.58
CO EMISSION RATE	LB/HR	4.13045	10.88686	176.85077	113.92928	67.03462	10.88686	4.13045	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.28684	1.19120	0.81504	0.66325	0.71548	1.19120	3.28684	
CO MASS / MODE	LB	0.06884	1.99592	0.88425	9.49410	6.70346	0.54434	0.06884	19.75975
CO MASS / RATED HP	LB/HP								0.08782
CO - PERCENT OF EPA STANDARD									209.10
NOX EMISSION RATE	LB/HR	0.00117	0.00612	0.13359	0.20945	0.12725	0.00612	0.00117	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00093	0.00067	0.00062	0.00122	0.00136	0.00067	0.00093	
NOX MASS / MODE	LB	0.00002	0.00112	0.00067	0.01745	0.01272	0.00031	0.00002	0.03231
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.57

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.11061	0.09580	0.10040	0.09411	0.09375	0.09580	0.11061	0.09823 TA
DIFF. CALC & MEAS F/A	PERCENT	10.31	17.38	-3.92	1.74	7.51	17.38	10.31	11.37 TA
DIFF EV & CB RATE	PERCENT	0.05	1.80	0.05	0.05	0.70	1.80	0.05	
SUM OF MOLE FRACTIONS		1.10547	1.14659	1.02977	1.05310	1.08487	1.14659	1.10547	

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TSIO-360-C S/N 300244 TEST 10 CONST HP,VAR. RPM & MAP RUNS 116-120 07/30/75

PBARO	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.859	81.00	79.00	2.1250	81.00	225.00	360.00	3.000	5.550	2.058

	UNITS	MODE 3	MODE 3	MODE 3	MODE 3	MODE 3	MODE 0	MODE 0
RUN NUMBER	--	116.	117.	118.	119.	120.		
TIME IN MODE	MINUTES	5.00	5.00	5.00	5.00	5.00		
FUEL FLOW	LB/HR	102.00	94.00	97.00	106.00	110.00		
INDUCTION AIR FLOW (W)	LB/HR	1126.00	1163.00	1130.00	1105.00	1112.00		
HYDROCARBON CONC.	PPM-C W	1980.00	1500.00	1710.00	2160.00	2310.00		
OXIDES OF NITROGEN CONC	PPM W	95.00	207.50	147.50	62.50	47.00		
CARBON MONOXIDE CONC.	PERCENT	11.40	9.50	10.25	12.40	12.95		
CARBON DIOXIDE CONC.	PERCENT	8.00	9.35	8.75	7.30	7.00		
OXYGEN CONC.	PERCENT	0.13	0.13	0.13	0.13	0.13		
WET CORRECTION FACTOR	--	0.83820	0.83089	0.83089	0.84882	0.85411		
PROP. TORQUE	FT-LB	352.00	317.00	336.00	364.00	371.00		
PROP. SPEED	RPM	2520.00	2800.00	2640.00	2440.00	2390.00		
MFLD PRESSURE	IN HG ABS DRY	33.00	28.80	31.00	35.10	36.50		
INDUCTION AIR TEMP	DEG F	93.00	95.00	95.00	95.00	95.00		
COOLING AIR TEMP	DEG F	98.00	100.00	101.00	102.00	102.00		
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00		
MAX CYL HEAD TEMP	DEG F	420.00	432.00	442.00	430.00	421.00		
EXHAUST GAS TEMP	DEG F	1385.00	1440.00	1420.00	1355.00	1340.00		
INDUCTION F/A RATIO (D)	LB/LB	0.09249	0.08252	0.08764	0.09794	0.10100		
IND. F/A EQUIV. RATIO	--	1.38	1.23	1.31	1.47	1.51		
ENGINE OBSERVED POWER	HP	168.90	169.00	168.90	169.11	168.83		
OBS BMEP	PSI	147.45	132.79	140.75	152.48	155.41		
OBS BSFC	LBM/BHP-HR	0.604	0.556	0.574	0.627	0.652		

CARBON BALANCE MASS EMISSIONS

	UNITS					
HC EMISSION RATE	LB/HR	1.20300	0.87425	1.01907	1.32529	1.44248
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00712	0.00517	0.00603	0.00784	0.00854
HC MASS / MODE	LB	0.10025	0.07285	0.08492	0.11044	0.12021
CO EMISSION RATE	LB/HR	117.20395	92.87436	102.46092	130.37146	139.43338
BRAKE SPECIFIC CO	LBM/BHP-HR	0.69394	0.54954	0.60665	0.77093	0.82589
CO MASS / MODE	LB	9.76659	7.73453	8.53841	10.86429	11.61945
NOX EMISSION RATE	LB/HR	0.19140	0.40102	0.29148	0.12716	0.09732
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00113	0.00237	0.00173	0.00075	0.00058
NOX MASS / MODE	LB	0.01595	0.03342	0.02429	0.01060	0.00811

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS					
CAL. FUEL AIR RATIO	LB/LB	0.09515	0.08870	0.09128	0.09893	0.10092
DIFF. CALC & MEAS F/A	PERCENT	2.87	7.49	4.15	1.01	-0.08
DIFF EV & CB RATE	PERCENT	0.05	1.03	0.10	0.05	0.05
SUM OF MOLE FRACTIONS		1.05381	1.05624	1.06050	1.04318	1.04200

TSIO-360-C S/N 300244 TEST 11 BASELINE (20 DEG BTC) RUNS 121-127 07/31/75

PBARC	TDRY	TINET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.985	77.00	74.00	2.1250	77.00	225.00	360.00	3.000	5.550	1.709

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	121.	122.	123.	124.	125.	126.	127.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.80	14.00	142.00	101.00	59.00	13.60	6.80	
INDUCTION AIR FLOW (W)	LB/HR	73.68	162.00	1390.00	1116.00	660.00	155.00	75.44	
HYDROCARBON CONC.	PPM-C W	86250.00	31500.00	2220.00	2010.00	2370.00	35250.00	91500.00	
OXIDES OF NITROGEN CONC	PPM W	7.75	30.00	46.00	92.50	92.50	26.50	8.00	
CARBON MONOXIDE CONC.	PERCENT	6.05	7.70	13.10	11.70	11.70	7.40	6.40	
CARBON DIOXIDE CONC.	PERCENT	6.20	8.75	6.80	8.00	8.00	8.65	5.75	
OXYGEN CONC.	PERCENT	7.25	2.50	0.13	0.13	0.13	2.75	7.75	
WET CORRECTION FACTOR	--	0.83677	0.83668	0.86662	0.83803	0.83668	0.83797	0.83668	
PROP. TORQUE	FT-LB	10.00	40.00	404.00	353.00	194.00	41.00	10.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
FELD PRESSURE	IN HG ABS DRY	18.70	16.00	37.00	33.00	21.50	16.10	18.90	
INDUCTION AIR TEMP	DEG F	80.00	81.00	88.00	87.00	86.00	84.00	85.00	
COOLING AIR TEMP	DEG F	92.00	92.00	90.00	90.00	90.00	93.00	94.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	266.00	320.00	432.00	425.00	350.00	332.00	281.00	
EXHAUST GAS TEMP	DEG F	650.00	900.00	1395.00	1375.00	1255.00	900.00	645.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09389	0.08792	0.10393	0.09208	0.09095	0.08927	0.09171	0.09003 TA
IND. F/A EQUIV. RATIO	--	1.40	1.32	1.55	1.38	1.36	1.34	1.37	1.35 TA
ENGINE OBSERVED POWER	HP	1.14	9.14	215.38	169.38	89.98	9.37	1.14	
OBS BMEP	PSI	4.19	16.76	169.23	147.87	81.26	17.17	4.19	
OBS BSFC	LBM/BHP-HR	5.952	1.532	0.659	0.596	0.656	1.452	5.952	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	3.04634	2.55632	1.76936	1.19108	0.81994	2.76893	3.15811	
BRAKE SPECIFIC HC	LBM/BHP-HR	2.66656	0.27970	0.00821	0.00703	0.00911	0.29558	2.76440	
HC MASS / MODE	LB	0.05077	0.46666	0.00885	0.09926	0.08199	0.13845	0.05264	0.90061
HC MASS / RATED HP	LB/HP								0.00400
HC - PERCENT OF EPA STANDARD									210.67
CO EMISSION RATE	LB/HR	3.60969	10.55463	182.66145	117.29530	68.37016	9.83330	3.73108	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.15968	1.15485	0.84807	0.69252	0.75982	1.04968	3.26594	
CO MASS / MODE	LB	0.06016	1.93502	0.91331	9.77460	6.83702	0.49166	0.06218	20.07393
CO MASS / RATED HP	LB/HP								0.08922
CO - PERCENT OF EPA STANDARD									212.42
NOX EMISSION RATE	LB/HR	0.00091	0.00807	0.12157	0.18176	0.10612	0.00690	0.00092	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00079	0.00088	0.00056	0.00107	0.00118	0.00074	0.00080	
NOX MASS / MODE	LB	0.00002	0.00148	0.00061	0.01515	0.01061	0.00035	0.00002	0.02822
NOX MASS / RATED HP	LB/HP								0.00013
NOX- PERCENT OF EPA STANDARD									8.36
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10722	0.09381	0.10179	0.09568	0.09589	0.09457	0.10956	0.09585 TA
DIFF. CALC & MEAS F/A	PERCENT	14.20	6.70	-2.07	3.92	5.43	5.94	19.48	6.47 TA
DIFF EV & CB RATE	PERCENT	0.05	0.26	0.05	0.05	0.28	0.05	0.89	
SUM OF MOLE FRACTIONS		1.11625	1.08857	1.02963	1.06798	1.07700	1.07713	1.15952	

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TSIO-360-C S/N 300244 TEST 12 BASELINE (20 DEG BTC) RUNS 128-132 08/21/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.094	83.00	79.00	2.1250	83.00	225.00	360.00	3.000	5.550	2.013

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	128.	129.	130.	131.	132.	129.	128.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	6.10	13.60	142.00	101.00	59.00	13.60	6.10	
INDUCTION AIR FLOW (W)	LB/HP	69.30	157.00	1409.00	1122.00	666.00	157.00	69.30	
HYDROCARBON CONC.	PPM-C W	85500.00	33000.00	2175.00	2010.00	2100.00	33000.00	85500.00	
OXIDES OF NITROGEN CONC	PPM W	8.10	28.00	45.00	87.50	97.50	28.00	8.10	
CARBON MONOXIDE CONC.	PERCENT	4.85	6.50	12.20	10.55	10.55	6.50	4.85	
CARBON DIOXIDE CONC.	PERCENT	6.15	8.35	6.60	7.75	7.90	8.35	6.15	
OXYGEN CONC.	PERCENT	7.75	3.15	0.75	0.80	0.80	3.15	7.75	
WET CORRECTION FACTOR	--	0.83680	0.85288	0.87724	0.85546	0.84955	0.85288	0.83680	
PROP. TORQUE	FT-LB	8.00	39.00	401.00	350.00	191.00	39.00	8.00	
PROP. SPEED	RPM	600.00	1200.00	2800.00	2520.00	2436.00	1200.00	600.00	
FELD PRESSURE IN HG ABS DRY		18.20	15.90	37.00	33.00	21.50	15.90	18.20	
INDUCTION AIR TEMP	DEG F	93.00	91.00	93.00	93.00	91.00	91.00	93.00	
COOLING AIR TEMP	DEG F	98.00	99.00	98.00	97.00	96.00	99.00	98.00	
COOLING AIR DELTA P	IN H2O	0.50	0.50	3.00	3.00	3.00	0.50	0.50	
MAX CYL HEAD TEMP	DEG F	250.00	322.00	438.00	427.00	356.00	322.00	250.00	
EXHAUST GAS TEMP	DEG F	650.00	900.00	1390.00	1370.00	1255.00	900.00	650.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08983	0.08840	0.10285	0.09187	0.09041	0.08840	0.08983	0.08974 TA
IND. F/A EQUIV. RATIO	--	1.34	1.32	1.54	1.37	1.35	1.32	1.34	1.34 TA
ENGINE OBSERVED POWER	HP	0.91	8.91	213.79	167.94	88.59	8.91	0.91	
OBS BMEP	PSI	3.35	16.34	167.97	146.61	80.01	16.34	3.35	
OBS BSFC	LBM/BHP-HR	6.674	1.526	0.664	0.601	0.666	1.526	6.674	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.87997	2.75605	1.81213	1.25526	0.76474	2.75605	2.87997	
BRAKE SPECIFIC HC	LBM/BHP-HR	3.15117	0.30929	0.00848	0.00747	0.00863	0.30929	3.15117	
HC MASS / MODE	LB	0.04800	0.50527	0.00906	0.10460	0.07647	0.13780	0.04800	0.92922
HC MASS / RATED HP	LB/HP								0.00413
HC - PERCENT OF EPA STANDARD									217.36
CO EMISSION RATE	LB/HR	2.75977	9.34672	180.00949	113.78296	65.89053	9.34672	2.75977	
BRAKE SPECIFIC CO	LBM/BHP-HR	3.01965	1.04891	0.84201	0.67754	0.74377	1.04891	3.01965	
CO MASS / MODE	LB	0.04600	1.71356	0.90005	9.48191	6.58905	0.46734	0.04600	19.24388
CO MASS / RATED HP	LB/HP								0.08553
CO - PERCENT OF EPA STANDARD									203.64
NOX EMISSION RATE	LB/HR	0.00090	0.00775	0.12432	0.18120	0.11774	0.00775	0.00090	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00059	0.00087	0.00058	0.00108	0.00133	0.00087	0.00099	
NOX MASS / MODE	LB	0.00002	0.00142	0.00062	0.01510	0.01177	0.00039	0.00002	0.02933
NOX MASS / RATED HP	LB/HP								0.00013
NOX - PERCENT OF EPA STANDARD									8.69
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10310	0.09048	0.09767	0.09121	0.09094	0.09048	0.10310	0.09172 TA
DIFF. CALC & MEAS F/A	PERCENT	14.77	2.35	-5.03	-0.71	0.59	2.35	14.77	2.20 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		1.08988	1.02999	1.00121	1.02490	1.03775	1.02999	1.08988	

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APPENDIX F. TIARA 6-285-B TEST DATA

6-285-B S/N 700106 TEST 1 BASELINE (30 DEG BTC) RUNS 1-7 09/15/75

PBARC	TDRY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.088	81.50	72.00	2.1250	81.50	285.00	406.00	3.000	5.550	1.446

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	9.90	31.90	151.00	116.00	83.00	30.90	9.80	
INDUCTION AIR FLOW (W)	LB/HR	118.00	360.00	1755.00	1400.00	960.00	370.00	120.00	
HYDROCARBON CONC.	PPM-C W	24600.00	4125.00	1875.00	1740.00	2520.00	3525.00	24080.00	
OXIDES OF NITROGEN CONC	PPM W	14.00	77.50	260.00	335.00	190.00	75.00	14.00	
CARBON MONOXIDE CONC.	PERCENT	9.15	10.40	9.30	9.15	9.50	9.85	8.65	
CARBON DIOXIDE CONC.	PERCENT	8.35	8.15	9.05	9.65	8.85	8.15	7.50	
OXYGEN CONC.	PERCENT	3.00	0.63	0.25	0.25	0.25	0.63	3.00	
WET CORRECTION FACTOR	--	0.84103	0.84876	0.84698	0.84103	0.84574	0.84103	0.84103	
FROP. TORQUE	FT-LB	38.00	162.00	725.00	640.00	405.00	158.00	37.00	
FROP. SPEED	RPM	600.00	1200.00	2000.00	1800.00	1740.00	1200.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.70	13.20	28.30	25.70	19.00	12.90	11.90	
INDUCTION AIR TEMP	DEG F	88.00	89.00	94.00	95.00	94.00	92.00	92.00	
COOLING AIR TEMP	DEG F	79.00	80.00	95.00	95.00	95.00	92.00	98.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	312.00	395.00	431.00	418.00	373.00	357.00	369.00	
EXHAUST GAS TEMP	DEG F	498.00	855.00	1333.00	1270.00	1125.00	855.00	492.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08513	0.08991	0.08730	0.08407	0.08773	0.08474	0.08286	0.08733 TA
IND. F/A EQUIV. RATIO	--	1.27	1.35	1.31	1.26	1.31	1.27	1.24	1.31 TA
ENGINE OBSERVED POWER	HP	4.34	37.01	276.09	219.35	134.18	36.10	4.25	
OBS BMEP	PSI	7.06	30.09	134.64	118.86	75.21	29.34	6.87	
OBS BSFC	LBM/BHP-HR	2.280	0.862	0.547	0.529	0.619	0.856	2.318	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.38997	0.79848	1.76469	1.23792	1.30023	0.68936	1.44277	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.32018	0.02157	0.00639	0.00564	0.00969	0.01910	0.34133	
HC MASS / MODE	LB	0.02317	0.14639	0.00882	0.10316	0.13002	0.03447	0.02405	0.47007
HC MASS / RATED HP	LB/HP								0.00165
HC - PERCENT OF EPA STANDARD									86.81
CO EMISSION RATE	LB/HR	8.77788	34.49397	149.66187	110.52571	83.68840	32.70546	8.82878	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.02195	0.93191	0.54209	0.50389	0.62371	0.90596	2.08868	
CO MASS / MODE	LB	0.14630	6.32389	0.74831	9.21047	8.36884	1.63527	0.14715	26.58022
CO MASS / RATED HP	LB/HP								0.09326
CO - PERCENT OF EPA STANDARD									222.06
NOX EMISSION RATE	LB/HR	0.00262	0.04974	0.81142	0.79031	0.32507	0.04864	0.00279	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00060	0.00134	0.00294	0.00360	0.00242	0.00135	0.00066	
NOX MASS / MODE	LB	0.00004	0.00912	0.00406	0.06586	0.03251	0.00243	0.00005	0.11406
NOX MASS / RATED HP	LB/HP								0.00040
NOX- PERCENT OF EPA STANDARD									26.68
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09099	0.09203	0.08858	0.08721	0.08968	0.09072	0.09153	0.09039 TA
DIFF. CALC & MEAS F/A	PERCENT	6.89	2.36	1.46	3.74	2.22	7.05	10.46	3.51 TA
DIFF EV & CB RATE	PERCENT	0.53	0.05	0.05	0.50	0.05	0.38	0.52	
SUM OF MOLE FRACTIONS		1.14266	1.04648	1.04004	1.08516	1.03825	1.04601	1.08353	

F-1

6-285-B S/N 700106 TEST 2 BASELINE (30 DEG BTC) RUNS 8-14 09/19/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.008	82.00	70.00	2.1250	82.00	285.00	406.00	1.000	5.550	1.200

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	10.70	33.40	153.00	116.00	83.00	31.80	10.40	
INDUCTION AIR FLOW (W)	LB/HR	120.00	380.00	1760.00	1400.00	970.00	380.00	120.00	
HYDROCARBON CONC.	PPM-C W	24000.00	4275.00	1800.00	1845.00	2550.00	3975.00	21200.00	
OXIDES OF NITROGEN CONC	PPM W	14.00	72.50	275.00	350.00	220.00	80.00	13.13	
CARBON MONOXIDE CONC.	PERCENT	9.00	10.55	9.00	8.15	9.30	10.00	9.15	
CARBON DIOXIDE CONC.	PERCENT	7.70	8.15	9.45	9.85	9.15	8.55	7.65	
OXYGEN CONC.	PERCENT	2.50	0.25	0.0	0.0	0.13	0.25	2.50	
WET CORRECTION FACTOR	--	0.85465	0.84376	0.85029	0.84376	0.84376	0.84376	0.84376	
FROP. TORQUE	FT-LB	35.00	163.00	722.00	625.00	416.00	159.00	36.00	
FROP. SPEED	RPM	600.00	1200.00	2000.00	1800.00	1740.00	1200.00	600.00	
FEED PRESSURE	IN HG ABS DRY	11.80	13.40	28.30	25.40	19.00	12.80	12.00	
INDUCTION AIR TEMP	DEG F	85.00	86.00	89.00	90.00	89.00	89.00	90.00	
COOLING AIR TEMP	DEG F	0.0	0.0	93.00	93.00	92.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	302.00	393.00	447.00	423.00	380.00	368.00	383.00	
EXHAUST GAS TEMP	DEG F	510.00	861.00	1345.00	1270.00	1140.00	860.00	505.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09032	0.08503	0.08806	0.08393	0.08668	0.08477	0.08779	0.08710 TA
IND. F/A EQUIV. RATIO	--	1.35	1.33	1.32	1.26	1.30	1.27	1.31	1.30 TA
ENGINE OBSERVED POWER	HP	4.00	37.24	274.94	214.20	137.82	34.33	4.11	
CBS BMEP	PSI	6.50	30.27	134.09	116.07	77.26	29.53	6.69	
CBS BSFC	LBM/BHP-HR	2.676	0.897	0.556	0.542	0.602	0.875	2.529	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.51008	0.86381	1.70158	1.36498	1.31146	0.77218	1.46056	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.37766	0.02319	0.00619	0.00637	0.00952	0.02126	0.35513	
HC MASS / MODE	LB	0.02517	0.15837	0.00851	0.11375	0.13115	0.03861	0.02434	0.49989
HC MASS / RATED HP	LB/HP								0.00175
HC - PERCENT OF EPA STANDARD									92.32
CO EMISSION RATE	LB/HR	9.77024	36.31133	146.04218	102.70567	81.47110	33.08920	9.60501	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.44349	0.97499	0.53117	0.47948	0.59113	0.91082	2.33544	
CO MASS / MODE	LB	0.16284	6.65708	0.73021	8.55880	8.14711	1.65446	0.16008	26.07054
CO MASS / RATED HP	LB/HP								0.09148
CO - PERCENT OF EPA STANDARD									217.80
NOX EMISSION RATE	LB/HR	0.00292	0.04658	0.86202	0.85863	0.37518	0.05153	0.00268	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00073	0.00130	0.00314	0.00401	0.00272	0.00142	0.00065	
NOX MASS / MODE	LB	0.00005	0.00891	0.00431	0.07155	0.03752	0.00258	0.00004	0.12496
NOX MASS / RATED HP	LB/HP								0.00044
NOX - PERCENT OF EPA STANDARD									29.23
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09364	0.09405	0.08831	0.08620	0.08930	0.09201	0.09401	0.09126 TA
DIFF. CALC.& MEAS F/A	PERCENT	3.67	5.64	0.29	2.70	3.02	8.54	7.08	4.78 TA
DIFF EV & CB RATE	PERCENT	0.05	0.28	0.05	0.16	0.09	1.02	0.06	
SUM OF MOLE FRACTIONS		1.05848	1.05082	1.03857	1.04002	1.04677	1.07705	1.07140	

F-2

6-285-B S/N 700106 TEST 3 BASELINE (30 DEG BTC) RUNS 15-21 09/19/75

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.008	82.00	70.00	2.1250	82.00	285.00	406.00	3.000	5.550	1.280

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	10.50	16.80	152.00	114.00	83.00	16.80	10.80	
INDUCTION AIR FLOW (W)	LB/HR	125.00	212.00	1760.00	1395.00	965.00	220.00	125.00	
HYDROCARBON CONC.	PPM-C W	21000.00	3750.00	1800.00	1845.00	2475.00	3750.00	26250.00	
OXIDES OF NITROGEN CONC	PPM W	15.50	73.00	300.00	385.00	245.00	73.00	13.50	
CARBON MONOXIDE CONC.	PERCENT	8.60	7.50	9.00	8.80	9.15	7.40	9.00	
CARBON DIOXIDE CONC.	PERCENT	8.10	9.55	9.35	9.95	9.15	9.95	7.45	
OXYGEN CONC.	PERCENT	2.25	0.50	0.0	0.0	0.0	0.50	2.50	
WET CORRECTION FACTOR	--	0.84376	0.84376	0.84848	0.84376	0.84475	0.84376	0.84376	
PROP. TORQUE	FT-LB	39.00	89.00	728.00	630.00	430.00	88.00	38.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.50	11.40	28.30	25.40	19.00	11.30	12.20	
INDUCTION AIR TEMP	DEG F	88.00	87.00	90.00	92.00	91.00	92.00	91.00	
COOLING AIR TEMP	DEG F	0.0	0.0	95.00	95.00	94.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	270.00	338.00	453.00	418.00	375.00	347.00	376.00	
EXHAUST GAS TEMP	DEG F	500.00	693.00	1348.00	1270.00	1140.00	718.00	490.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08509	0.08027	0.08748	0.08278	0.08713	0.07735	0.08752	0.08244 TA
IND. F/A EQUIV. RATIO	--	1.27	1.20	1.31	1.24	1.30	1.16	1.31	1.23 TA
ENGINE OBSERVED POWER	HP	4.46	15.25	277.23	215.92	142.46	15.08	4.34	
CBS BMEP	PSI	7.24	16.53	135.20	117.00	79.86	16.34	7.06	
CBS BSFC	LBM/BHP-HR	2.357	1.102	0.548	0.528	0.583	1.114	2.488	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.33521	0.40908	1.70317	1.28841	1.28228	0.41138	1.68403	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.29968	0.02682	0.00614	0.00597	0.00900	0.02728	0.38792	
HC MASS / MODE	LB	0.02225	0.07500	0.00852	0.10737	0.12823	0.02057	0.02807	0.39000
HC MASS / RATED HP	LB/HP								0.00137
HC - PERCENT OF EPA STANDARD									72.02
CO EMISSION RATE	LB/HR	9.31355	13.93631	145.86568	104.67572	80.84357	13.82776	9.83488	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.09046	0.91378	0.52616	0.48479	0.56748	0.91696	2.26547	
CO MASS / MODE	LB	0.15523	2.55459	0.72933	8.72297	8.08435	0.69139	0.16391	21.10216
CO MASS / RATED HP	LB/HP								0.07404
CO - PERCENT OF EPA STANDARD									176.29
NOX EMISSION RATE	LB/HR	0.00327	0.02641	0.94127	0.89151	0.42090	0.02655	0.00287	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00073	0.00173	0.00340	0.00413	0.00295	0.00176	0.00066	
NOX MASS / MODE	LB	0.00005	0.00484	0.00471	0.07429	0.04209	0.00133	0.00005	0.12736
NOX MASS / RATED HP	LB/HP								0.00045
NOX- PERCENT OF EPA STANDARD									29.79
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09165	0.08401	0.08849	0.08716	0.08951	0.08383	0.09571	0.08654 TA
DIFF. CALC & MEAS F/A	PERCENT	7.71	4.66	1.15	5.30	2.74	8.38	9.35	4.97 TA
DIFF EV & CB RATE	PERCENT	0.34	0.50	0.05	0.95	0.05	1.24	0.33	
SUM OF MOLE FRACTIONS		1.07348	1.05500	1.03547	1.09348	1.03446	1.07706	1.06699	

6-285-B S/N 700106 TEST 4 BASELINE (30 DEG BTC) RUNS 22-28 09/22/75

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
29.928	66.00	65.00	2.1250	66.00	285.00	406.00	3.000	5.550	1.277

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	28.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	10.90	17.40	156.00	118.00	85.00	16.30	10.60	
INDUCTION AIR FLOW (W)	LB/HR	120.00	220.00	1790.00	1440.00	1000.00	220.00	120.00	
HYDROCARBON CONC.	PPM-C W	24000.00	4200.00	1800.00	1830.00	2460.00	3900.00	25500.00	
OXIDES OF NITROGEN CONC	PPM W	12.75	68.00	275.00	365.00	230.00	66.00	10.75	
CARBON MONOXIDE CONC.	PERCENT	9.40	8.30	9.15	8.15	9.40	7.75	9.40	
CARBON DIOXIDE CONC.	PERCENT	7.70	9.60	9.35	9.95	9.15	9.80	7.45	
OXYGEN CONC.	PERCENT	2.25	0.63	0.13	0.13	0.13	0.63	2.50	
WET CORRECTION FACTOR	--	0.85327	0.84381	0.85172	0.84381	0.84381	0.84381	0.84454	
PROP. TORQUE	FT-LB	35.00	40.00	750.00	653.00	447.00	88.00	39.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.80	11.50	28.30	25.70	19.00	11.30	12.10	
INDUCTION AIR TEMP	DEG F	74.00	73.00	74.00	75.00	74.00	75.00	75.00	
COOLING AIR TEMP	DEG F	0.0	0.0	76.00	76.00	76.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	290.00	368.00	427.00	403.00	361.00	343.00	365.00	
EXHAUST GAS TEMP	DEG F	520.00	690.00	1342.00	1270.00	1131.00	695.00	480.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09201	0.08011	0.08828	0.08300	0.08610	0.07505	0.08948	0.08227 TA
IND. F/A EQUIV. RATIO	--	1.38	1.20	1.32	1.24	1.29	1.12	1.34	1.23 TA
ENGINE OBSERVED POWER	HP	4.00	6.85	285.61	223.80	148.09	15.08	4.46	
OBS BMEP	PSI	6.50	7.43	139.29	121.27	83.01	16.34	7.24	
OBS BSFC	LBM/BHP-HR	2.726	2.538	0.546	0.527	0.574	1.081	2.379	

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CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.50949	0.46153	1.72744	1.36977	1.28945	0.41006	1.57925	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.37752	0.06733	0.00605	0.00612	0.00871	0.02719	0.35445	
HC MASS / MODE	LB	0.02516	0.08461	0.00864	0.11415	0.12894	0.02050	0.02632	0.40833
HC MASS / RATED HP	LB/HP								0.00143
HC - PERCENT OF EPA STANDARD									75.41
CO EMISSION RATE	LB/HR	10.18401	15.53666	150.98586	103.91629	83.93164	13.88090	9.92531	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.54657	2.26663	0.52865	0.46433	0.56675	0.92049	2.22768	
CO MASS / MODE	LB	0.16973	2.84839	0.75493	8.65969	8.39316	0.69404	0.16542	21.68535
CO MASS / RATED HP	LB/HP								0.07609
CO - PERCENT OF EPA STANDARD									181.16
NOX EMISSION RATE	LB/HR	0.00266	0.02478	0.87513	0.90593	0.39976	0.02301	0.00221	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00067	0.00361	0.00306	0.00405	0.00270	0.00153	0.00050	
NOX MASS / MODE	LB	0.00004	0.00454	0.00438	0.07549	0.03998	0.00115	0.00004	0.12562
NOX MASS / RATED HP	LB/HP								0.00044
NOX- PERCENT OF EPA STANDARD									29.38

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09543	0.08570	0.08824	0.08555	0.08942	0.08427	0.09592	0.08709 TA
DIFF. CALC & MEAS F/A	PERCENT	3.72	6.97	-0.04	3.06	3.86	12.28	7.20	5.86 TA
DIFF EV & CB RATE	PERCENT	0.05	0.99	0.05	0.31	0.30	2.02	0.05	
SUM OF MOLE FRACTIONS		1.06313	1.08659	1.04233	1.05489	1.05680	1.11500	1.06971	

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6-285-B S/N 700106 TEST 4A IDLE RPM VARIATION RUNS 29-31 09/30/75

PBARC	TCRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.061	76.00	72.00	2.1250	76.00	285.00	406.00	3.000	5.550	1.569

	UNITS	MODE 1	MODE 1	MODE 1	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	29.	30.	31.				
TIME IN MODE	MINUTES	1.00	1.00	1.00				
FUEL FLOW	LB/HR	11.00	9.50	7.20				
INDUCTION AIR FLOW (W)	LB/HR	125.00	105.00	80.00				
HYDROCARBON CONC.	PPM-C W	19500.00	33000.00	47250.00				
OXIDES OF NITROGEN CONC	PPM W	13.25	7.50	6.75				
CARBON MONOXIDE CONC.	PERCENT	9.40	9.15	7.90				
CARBON DIOXIDE CONC.	PERCENT	7.70	6.95	6.50				
OXYGEN CONC.	PERCENT	1.87	3.13	5.00				
WET CORRECTION FACTOR	--	0.84299	0.84791	0.85932				
PROP. TORQUE	FT-LB	44.00	33.00	22.00				
PROP. SPEED	RPM	600.00	500.00	375.00				
WELD PRESSURE	IN HG ABS DRY	11.50	12.50	13.80				
INDUCTION AIR TEMP	DEG F	80.00	81.00	81.00				
COOLING AIR TEMP	DEG F	0.0	0.0	0.0				
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0				
MAX CYL HEAD TEMP	DEG F	348.00	360.00	364.00				
EXHAUST GAS TEMP	DEG F	502.00	464.00	390.00				
INDUCTION F/A RATIO (D)	LB/LB	0.08940	0.09192	0.09143				
IND. F/A EQUIV. RATIO	--	1.34	1.38	1.37				
ENGINE OBSERVED POWER	HP	5.03	3.14	1.57				
OBS BMEP	PSI	8.17	6.13	4.09				
OBS BSFC	LBM/BHP-HR	2.188	3.024	4.584				
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.28504	1.81318	1.95059				
BRAKE SPECIFIC HC	LBM/BHP-HR	0.25565	0.57714	1.24176				
HC MASS / MODE	LB	0.02142	0.03022	0.03251				
CO EMISSION RATE	LB/HR	10.54190	8.60569	5.65763				
BRAKE SPECIFIC CO	LBM/BHP-HR	2.09720	2.73922	3.60168				
CO MASS / MODE	LB	0.17570	0.14343	0.09429				
NOX EMISSION RATE	LB/HR	0.00250	0.00137	0.00092				
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00058	0.00043	0.00059				
NOX MASS / MODE	LB	0.00005	0.00002	0.00002				
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09472	0.09820	0.09653				
DIFF. CALC & MEAS F/A	PERCENT	5.94	6.83	5.57				
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05				
SUM OF MOLE FRACTIONS		1.05187	1.05866	1.06583				

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6-285-B S/N 700106 TEST 4B BASELINE (30 DEG BTC) RUNS 32-38 10/01/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.965	71.00	69.50	2.1250	71.00	285.00	406.00	3.000	5.550	1.488

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	32.	33.	34.	35.	36.	37.	38.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	10.90	17.00	152.00	116.00	74.00	18.00	10.70	
INDUCTION AIR FLOW (W)	LB/HR	125.00	210.00	1765.00	1445.00	865.00	210.00	120.00	
HYDROCARBON CONC.	PPM-C W	16500.00	4650.00	1075.00	1075.00	2700.00	4275.00	23250.00	
OXIDES OF NITROGEN CONC	PPM W	13.00	53.00	285.00	365.00	160.00	55.00	10.25	
CARBON MONOXIDE CONC.	PERCENT	9.70	9.00	9.00	7.90	9.90	8.00	9.70	
CARBON DIOXIDE CONC.	PERCENT	8.15	9.15	9.55	9.95	9.85	9.55	7.70	
OXYGEN CONC.	PERCENT	1.00	0.50	0.0	0.0	0.13	0.50	1.75	
WET CORRECTION FACTOR	--	0.84034	0.84034	0.84105	0.84034	0.84034	0.84034	0.84034	
PROP. TORQUE	FT-LB	38.00	84.00	740.00	655.00	355.00	82.00	38.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	400.00	600.00	
FELD PRESSURE	IN HG ABS DRY	11.10	10.80	28.30	25.70	16.50	10.50	11.40	
INDUCTION AIR TEMP	DEG F	78.00	77.00	79.00	80.00	80.00	80.00	80.00	
COOLING AIR TEMP	DEG F	0.0	0.0	81.00	83.00	82.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	309.00	366.00	439.00	408.00	355.00	342.00	365.00	
EXHAUST GAS TEMP	DEG F	540.00	655.00	1350.00	1275.00	1085.00	685.00	540.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08852	0.08217	0.08644	0.08149	0.08684	0.07734	0.09851	0.08313 TA
IND. F/A EQUIV. RATIO	--	1.32	1.23	1.29	1.22	1.30	1.16	1.39	1.24 TA
ENGINE OBSERVED POWER	HP	4.34	14.39	281.80	224.49	117.61	6.75	4.34	
OBS BMEP	PSI	7.06	15.60	137.43	121.64	65.93	15.23	7.06	
OBS BSFC	LBM/BHP-HR	2.511	1.181	0.539	0.517	0.629	2.562	2.465	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.05902	0.45310	1.76970	1.40404	1.16138	0.44190	1.43921	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.24395	0.03426	0.00628	0.00625	0.00987	0.07076	0.33152	
HC MASS / MODE	LB	0.01765	0.09040	0.00885	0.11700	0.11614	0.02209	0.02399	0.39612
HC MASS / RATED HP	LB/HP								0.00139
HC - PERCENT OF EPA STANDARD									73.15
CO EMISSION RATE	LB/HR	10.56166	16.19075	144.22783	100.35687	72.24149	14.02873	10.18627	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.43289	1.12479	0.51181	0.44705	0.61423	2.24631	2.34662	
CO MASS / MODE	LB	0.17603	2.96830	0.72114	8.36307	7.22414	0.70144	0.16977	20.32388
CO MASS / RATED HP	LB/HP								0.07131
CO - PERCENT OF EPA STANDARD									169.79
NOX EMISSION RATE	LB/HR	0.00277	0.01864	0.89197	0.90631	0.22821	0.01885	0.00210	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00064	0.00129	0.00317	0.00404	0.00194	0.00302	0.00048	
NOX MASS / MODE	LB	0.00005	0.00342	0.00446	0.07553	0.02282	0.00094	0.00004	0.10725
NOX MASS / RATED HP	LB/HP								0.00038
NOX - PERCENT OF EPA STANDARD									25.09
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09634	0.08842	0.08819	0.08563	0.08913	0.08579	0.09796	0.08841 TA
DIFF. CALC & MEAS F/A	PERCENT	8.84	7.60	2.03	5.08	2.64	10.92	8.23	6.36 TA
DIFF EV & CB RATE	PERCENT	0.73	0.96	0.05	0.60	0.58	1.61	0.35	
SUM OF MOLE FRACTIONS		1.07405	1.08208	1.04965	1.05208	1.11758	1.09121	1.07228	

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6-285-B S/N 700106 TEST 4C CONST POWER,VAR RPM & MAP RUNS 39-44 10/01/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
IN HG ABS	DEG F	DEG F		DEG F					
29.948	77.00	72.00	2.1250	77.00	285.00	406.00	3.000	5.550	1.547

	UNITS	MODE 4	MODE 4	MODE 4	MODE 5	MODE 5	MODE 5	MODE 0
RUN NUMBER	--	39.	40.	41.	42.	43.	44.	
TIME IN MODE	MINUTES	5.00	5.00	5.00	6.00	6.00	6.00	
FUEL FLOW	LB/HR	111.00	106.00	111.00	65.00	68.00	71.00	
INDUCTION AIR FLOW (W)	LB/HR	1340.00	1300.00	1330.00	755.00	785.00	790.00	
HYDROCARBON CONC.	PPM-C W	2040.00	1935.00	2025.00	2775.00	2775.00	2850.00	
OXIDES OF NITROGEN CONC	PPM W	360.00	325.00	360.00	180.00	171.25	146.25	
CARBON MONOXIDE CONC.	PERCENT	8.20	8.35	8.20	9.50	9.75	10.00	
CARBON DIOXIDE CONC.	PERCENT	9.90	9.65	9.75	8.95	8.85	8.65	
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	
WET CORRECTION FACTOR	--	0.83937	0.83937	0.84153	0.83937	0.83937	0.84873	
PROP. TORQUE	FT-LB	615.00	627.00	570.00	368.00	355.00	329.00	
PROP. SPEED	RPM	1800.00	1700.00	1900.00	1500.00	1600.00	1710.00	
MFLD PRESSURE	IN HG ABS DRY	24.40	25.00	23.00	17.50	16.70	15.70	
INDUCTION AIR TEMP	DEG F	85.00	85.00	85.00	84.00	84.00	85.00	
COOLING AIR TEMP	DEG F	90.00	91.00	91.00	91.00	91.00	91.00	
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00	3.00	
MAX CYL HEAD TEMP	DEG F	399.00	399.00	413.00	350.00	345.00	343.00	
EXHAUST GAS TEMP	DEG F	1255.00	1237.00	1260.00	1040.00	1055.00	1068.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08414	0.08282	0.08477	0.08745	0.08799	0.09129	
IND. F/A EQUIV. RATIO	—	1.26	1.24	1.27	1.31	1.32	1.37	
ENGINE OBSERVED POWER	HP	210.78	202.95	206.21	105.10	108.15	107.12	
CBS BMEP	PSI	114.21	116.44	105.86	68.34	65.93	61.10	
CBS BSFC	LBM/BHP-HR	0.527	0.522	0.538	0.618	0.629	0.663	

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CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 4	MODE 4	MODE 4	MODE 5	MODE 5	MODE 5
HC EMISSION RATE	LB/HR	1.44191	1.31415	1.43960	1.12182	1.16430	1.23116
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00684	0.00648	0.00698	0.01067	0.01077	0.01149
HC MASS / MODE	LB	0.12016	0.10951	0.11997	0.11218	0.11643	0.12312
CO EMISSION RATE	LB/HR	98.21112	96.09221	99.03398	65.07623	69.31767	74.01584
BRAKE SPECIFIC CO	LBM/BHP-HR	0.46595	0.47347	0.48026	0.61917	0.64094	0.69097
CO MASS / MODE	LB	8.18426	8.00768	8.25283	6.50762	6.93177	7.40158
NOX EMISSION RATE	LB/HR	0.84376	0.73190	0.84864	0.24129	0.23825	0.20949
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00400	0.00361	0.00412	0.00230	0.00220	0.00196
NOX MASS / MODE	LB	0.07031	0.06099	0.07072	0.02413	0.02383	0.02095

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 4	MODE 4	MODE 4	MODE 5	MODE 5	MODE 5
CAL. FUEL AIR RATIO	LB/LB	0.08632	0.08693	0.08655	0.09069	0.09133	0.09222
DIFF. CALC & MEAS F/A	PERCENT	2.60	4.96	2.10	3.72	3.81	1.02
DIFF EX & CB RATE	PERCENT	0.11	0.50	0.05	0.08	0.09	0.05
SUM OF MOLE FRACTIONS		1.04354	1.04880	1.03213	1.03901	1.04289	1.03115

6-285-B S/N 700106 TEST 5 LEANOUT 30 DEG BTC RUNS 45,49,52,60,68 10/02/75

PBARO	TDRY	TMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	3.000	5.550	1.067

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	45.	49.	52.	60.	68.	49.	45.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	10.70	16.50	152.00	116.00	74.50	16.50	10.70	
INDUCTION AIR FLOW (W)	LB/HR	120.00	210.00	1790.00	1420.00	845.00	210.00	120.00	
HYDROCARBON CONC.	PPM-C W	20250.00	3900.00	1740.00	1770.00	2610.00	3900.00	20250.00	
OXIDES OF NITROGEN CONC	PPM W	13.13	65.50	310.00	440.00	190.00	65.50	13.13	
CARBON MONOXIDE CONC.	PERCENT	9.25	8.10	8.80	7.65	9.80	8.10	9.25	
CARBON DIOXIDE CONC.	PERCENT	7.90	9.65	9.45	9.95	8.75	9.65	7.90	
OXYGEN CONC.	PERCENT	1.88	0.63	0.0	0.13	0.13	0.63	1.88	
WET CORRECTION FACTOR	--	0.85192	0.84725	0.84725	0.84725	0.85082	0.84725	0.85192	
PROP. TORQUE	FT-LB	36.00	85.00	730.00	643.00	345.00	85.00	36.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
FIELD PRESSURE	IN HG ABS DRY	11.20	10.80	28.25	25.70	16.50	10.80	11.20	
INDUCTION AIR TEMP	DEG F	73.00	77.00	79.00	82.00	81.00	77.00	73.00	
COOLING AIR TEMP	DEG F	0.0	0.0	84.00	85.00	86.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	309.00	349.00	440.00	414.00	349.00	349.00	309.00	
EXHAUST GAS TEMP	DEG F	532.00	670.00	1342.00	1274.00	1080.00	670.00	532.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09013	0.07942	0.08583	0.08257	0.08912	0.07942	0.09013	0.08298 TA
IND. F/A EQUIV. RATIO	--	1.35	1.19	1.28	1.24	1.33	1.19	1.35	1.24 TA
ENGINE OBSERVED POWER	HP	4.11	14.57	277.99	220.37	114.30	14.57	4.11	
CBS BMEP	PSI	6.69	15.79	135.57	119.41	64.07	15.79	6.69	
CBS BSFC	LBM/BHP-HR	2.602	1.133	0.547	0.526	0.652	1.133	2.602	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.27698	0.40891	1.65832	1.33411	1.18823	0.40891	1.27698	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.31049	0.02807	0.00597	0.00605	0.01040	0.02807	0.31049	
HC MASS / MODE	LB	0.02128	0.07497	0.00829	0.11118	0.11882	0.02045	0.02128	0.37627
HC MASS / RATED HP	LB/HP								0.00132
HC - PERCENT OF EPA STANDARD									69.49
CO EMISSION RATE	LB/HR	10.03196	14.52602	143.44940	98.62277	76.63202	14.52602	10.03196	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.43925	0.99726	0.51602	0.44753	0.67045	0.99726	2.43925	
CO MASS / MODE	LB	0.16720	2.66310	0.71725	8.21856	7.66320	0.72630	0.16720	20.32278
CO MASS / RATED HP	LB/HP								0.07131
CO - PERCENT OF EPA STANDARD									169.78
NOX EMISSION RATE	LB/HR	0.00274	0.02277	0.97969	1.09971	0.28683	0.02277	0.00274	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00067	0.00156	0.00352	0.00499	0.00251	0.00156	0.00067	
NOX MASS / MODE	LB	0.00005	0.00417	0.00490	0.09164	0.02868	0.00114	0.00005	0.13063
NOX MASS / RATED HP	LB/HP								0.00046
NOX- PERCENT OF EPA STANDARD									30.56

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09428	0.08509	0.08793	0.08463	0.09098	0.08509	0.09428	0.08701 TA
DIFF. CALC & MEAS F/A	PERCENT	4.60	7.15	2.45	2.49	2.09	7.15	4.60	4.85 TA
DIFF EV & CB RATE	PERCENT	0.05	1.05	0.08	0.10	0.05	1.05	0.05	
SUM OF MOLE FRACTIONS		1.05506	1.08379	1.03862	1.03061	1.03819	1.08379	1.05506	

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6-285-B S/N 700106 TEST 5A LEANOUT 30 DEG BTC RUNS 46,50,53,61,69 10/02/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	3.000	5.550	1.067

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	46.	50.	53.	61.	69.	50.	46.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	9.00	14.00	140.00	110.00	70.00	14.00	9.00	
INDUCTION AIR FLOW (W)	LB/HR	115.00	205.00	1780.00	1418.00	845.00	205.00	115.00	
HYDROCARBON CONC.	PPM-C W	12900.00	2850.00	1470.00	1575.00	2355.00	2850.00	12900.00	
OXIDES OF NITROGEN CONC	PPM W	21.87	147.75	1587.50	725.00	320.00	143.75	21.87	
CARBON MONOXIDE CONC.	PERCENT	8.60	3.60	6.55	6.60	8.15	3.60	8.60	
CARBON DIOXIDE CONC.	PERCENT	8.75	12.10	10.70	10.90	9.75	12.10	8.75	
OXYGEN CONC.	PERCENT	0.87	0.50	0.13	0.13	0.13	0.50	0.87	
WET CORRECTION FACTOR	--	0.84725	0.84725	0.84725	0.84725	0.84725	0.84725	0.84725	
PROP. TORQUE	FT-LB	37.00	86.00	745.00	651.00	350.00	86.00	37.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.30	11.10	28.30	25.70	16.50	11.10	11.30	
INDUCTION AIR TEMP	DEG F	80.00	77.00	79.00	82.00	81.00	77.00	80.00	
COOLING AIR TEMP	DEG F	0.0	0.0	84.00	86.00	86.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	367.00	409.00	459.00	419.00	353.00	409.00	367.00	
EXHAUST GAS TEMP	DEG F	500.00	710.00	1392.00	1305.00	1110.00	710.00	500.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07910	0.06903	0.07950	0.07841	0.08373	0.06903	0.07910	0.07483 TA
IND. F/A EQUIV. RATIO	--	1.18	1.03	1.19	1.17	1.25	1.03	1.18	1.12 TA
ENGINE OBSERVED POWER	HP	4.23	14.74	283.70	223.11	115.96	14.74	4.23	
CBS BMEP	PSI	6.87	15.97	138.36	120.90	65.00	15.97	6.87	
CBS BSFC	LBM/BHP-HR	2.129	0.950	0.493	0.493	0.604	0.950	2.129	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.71187	0.28792	1.36681	1.13356	1.04940	0.28792	0.71187	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.16841	0.01954	0.00482	0.00508	0.00905	0.01954	0.16841	
HC MASS / MODE	LB	0.01186	0.05278	0.00683	0.09446	0.10494	0.01440	0.01186	0.29715
HC MASS / RATED HP	LB/HP								0.00104
HC - PERCENT OF EPA STANDARD									54.87
CO EMISSION RATE	LB/HR	8.11718	6.22041	104.16673	81.24654	62.11636	6.22041	8.11718	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.92033	0.42209	0.36717	0.36415	0.53569	0.42209	1.92033	
CO MASS / MODE	LB	0.13529	1.14041	0.52083	6.77054	6.21163	0.31102	0.13529	15.22501
CO MASS / RATED HP	LB/HP								0.05342
CO - PERCENT OF EPA STANDARD									127.19
NOX EMISSION RATE	LB/HR	0.00400	0.04949	4.89453	1.73025	0.47283	0.04815	0.00400	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00095	0.00336	0.01725	0.00775	0.00408	0.00327	0.00095	
NOX MASS / MODE	LB	0.00007	0.00907	0.02447	0.14419	0.04728	0.00241	0.00007	0.22756
NOX MASS / RATED HP	LB/HP								0.00080
NOX- PERCENT OF EPA STANDARD									53.23
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09159	0.07441	0.08153	0.08145	0.08614	0.07441	0.09159	0.07961 TA
DIFF. CALC & MEAS F/A	PERCENT	15.79	7.79	2.56	3.88	2.87	7.79	15.79	6.39 TA
DIFF EV & CB RATE	PERCENT	2.27	1.27	0.19	0.66	0.20	1.27	2.27	
SUM OF MOLE FRACTIONS		1.11412	1.05655	1.03657	1.06192	1.04079	1.05655	1.11412	

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6-285-B S/N 700106 TEST 5B LEANOUT 30 DEG BTC RUNS 47,51,54,62,70 10/02/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	5.000	5.550	1.067

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	47.	51.	54.	62.	70.	51.	47.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	8.10	13.00	130.00	105.00	65.00	13.00	8.10	
INDUCTION AIR FLOW (W)	LB/HR	115.00	207.00	1770.00	1418.00	845.00	207.00	115.00	
HYDROCARBON CONC.	PPM-C W	7200.00	1710.00	1275.00	1425.00	2025.00	1710.00	7200.00	
OXIDES OF NITROGEN CONC	PPM W	37.50	193.75	1287.50	1100.00	625.00	193.75	37.50	
CARBON MONOXIDE CONC.	PERCENT	5.80	1.60	4.45	4.70	6.05	1.60	5.80	
CARBON DIOXIDE CONC.	PERCENT	10.50	13.00	11.75	11.65	11.00	13.00	10.50	
OXYGEN CONC.	PERCENT	1.00	0.50	0.13	0.13	0.13	0.50	1.00	
WET CORRECTION FACTOR	--	0.84725	0.84725	0.84725	0.84725	0.84725	0.84725	0.84725	
PROP. TORQUE	FT-LB	39.00	83.00	742.00	645.00	355.00	83.00	39.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
FELD PRESSURE	IN HG ABS DRY	11.40	11.60	28.30	25.70	16.50	11.60	11.40	
INDUCTION AIR TEMP	DEG F	81.00	77.00	80.00	82.00	81.00	77.00	81.00	
COOLING AIR TEMP	DEG F	0.0	0.0	85.00	86.00	86.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	383.00	440.00	474.00	423.00	362.00	440.00	383.00	
EXHAUST GAS TEMP	DEG F	490.00	745.00	1430.00	1332.00	1145.00	745.00	490.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07119	0.06348	0.07424	0.07485	0.07775	0.06348	0.07119	0.06938 TA
IND. F/A EQUIV. RATIO	--	1.07	0.95	1.11	1.12	1.16	0.95	1.07	1.04 TA
ENGINE OBSERVED POWER	HP	4.46	14.22	282.56	221.06	117.61	14.22	4.46	
CBS BMEP	PSI	7.24	15.41	137.80	119.79	65.93	15.41	7.24	
CBS BSFC	LBM/BHP-HR	1.818	0.914	0.460	0.475	0.553	0.914	1.818	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.39351	0.17379	1.17306	1.04819	0.88098	0.17379	0.39351	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.08832	0.01222	0.00415	0.00474	0.00749	0.01222	0.08832	
HC MASS / MODE	LB	0.00656	0.03186	0.00587	0.08735	0.08810	0.00869	0.00656	0.23498
HC MASS / RATED HP	LB/HP								0.00082
HC - PERCENT OF EPA STANDARD									43.39
CO EMISSION RATE	LB/HR	5.42187	2.78127	70.02736	59.13165	45.01880	2.78127	5.42187	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.21691	0.19555	0.24783	0.26749	0.38277	0.19555	1.21691	
CO MASS / MODE	LB	0.09036	0.50990	0.35014	4.92764	4.50188	0.13906	0.09036	10.60934
CO MASS / RATED HP	LB/HP								0.03723
CO - PERCENT OF EPA STANDARD									88.63
NOX EMISSION RATE	LB/HR	0.00680	0.06529	3.92794	2.68302	0.90163	0.06529	0.00680	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00153	0.00459	0.01390	0.01214	0.00767	0.00459	0.00153	
NOX MASS / MODE	LB	0.00011	0.01197	0.01964	0.22359	0.09016	0.00326	0.00011	0.34885
NOX MASS / RATED HP	LB/HP								0.00122
NOX- PERCENT OF EPA STANDARD									81.60

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.08033	0.06961	0.07663	0.07725	0.08062	0.06961	0.08033	0.07429 TA
DIFF. CALC & MEAS F/A	PERCENT	12.83	9.65	3.22	3.21	3.68	9.65	12.83	7.07 TA
DIFF EV & CB RATE	PERCENT	2.05	1.45	0.32	0.35	0.52	1.45	2.05	
SUM OF MOLE FRACTIONS		1.10192	1.03970	1.02159	1.02570	1.04354	1.03970	1.10192	

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6-285-B S/N 700106 TEST 5C LEANOUT 30 DEG BTC RUNS 48,51,55,63,71 10/02/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	3.000	5.550	1.067

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	48.	51.	55.	63.	71.	51.	48.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.40	13.00	125.00	100.00	60.00	13.00	7.40	
INDUCTION AIR FLOW (W)	LB/HR	110.00	207.00	1768.00	1395.00	845.00	207.00	110.00	
HYDROCARBON CONC.	PPM-C W	7500.00	1710.00	1050.00	1350.00	1830.00	1710.00	7500.00	
OXIDES OF NITROGEN CONC	PPM W	37.00	193.75	1937.50	1437.50	1100.00	193.75	37.00	
CARBON MONOXIDE CONC.	PERCENT	4.90	1.60	3.00	3.90	3.70	1.60	4.90	
CARBON DIOXIDE CONC.	PERCENT	10.80	13.00	12.65	12.00	12.10	13.00	10.80	
OXYGEN CONC.	PERCENT	1.38	0.50	0.13	0.13	0.25	0.50	1.38	
WET CORRECTION FACTOR	--	0.84725	0.84725	0.84725	0.84725	0.84725	0.84725	0.84725	
PROP. TORQUE	FT-LB	39.00	83.00	738.00	642.00	355.00	83.00	39.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MELD PRESSURE	IN HG ABS DRY	11.50	11.60	28.30	25.70	16.50	11.60	11.50	
INDUCTION AIR TEMP	DEG F	81.00	77.00	81.00	82.00	82.00	77.00	81.00	
COOLING AIR TEMP	DEG F	0.0	0.0	85.00	86.00	86.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	405.00	440.00	476.00	423.00	368.00	440.00	405.00	
EXHAUST GAS TEMP	DEG F	505.00	745.00	1468.00	1345.00	1182.00	745.00	505.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06800	0.06348	0.07146	0.07246	0.07177	0.06348	0.06800	0.06736 TA
INC. F/A EQUIV. RATIO	--	1.02	0.95	1.07	1.08	1.07	0.95	1.02	1.01 TA
ENGINE OBSERVED POWER	HP	4.46	14.22	281.04	220.03	117.61	14.22	4.46	
OBS BMEP	PSI	7.24	15.41	137.06	119.23	65.93	15.41	7.24	
OBS BSFC	LBM/BHP-HR	1.661	0.914	0.445	0.454	0.510	0.914	1.661	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.38723	0.17379	0.96285	0.97276	0.79332	0.17379	0.38723	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.08691	0.01222	0.00343	0.00442	0.00675	0.01222	0.08691	
HC MASS / MODE	LB	0.00645	0.03186	0.00481	0.08106	0.07933	0.00869	0.00645	0.21867
HC MASS / RATED HP	LB/HP								0.00077
HC - PERCENT OF EPA STANDARD									40.38
CO EMISSION RATE	LB/HR	4.32715	2.78127	47.05295	48.06535	27.43433	2.78127	4.32715	
BRAKE SPECIFIC CO	LBM/BHP-HR	0.97120	0.19555	0.16743	0.21845	0.23326	0.19555	0.97120	
CO MASS / MODE	LB	0.07212	0.50990	0.23526	4.00545	2.74343	0.13906	0.07212	7.77734
CO MASS / RATED HP	LB/HP								0.02729
CO - PERCENT OF EPA STANDARD									64.97
NOX EMISSION RATE	LB/HR	0.00633	0.06529	5.89137	3.43467	1.58123	0.06529	0.00633	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00142	0.00459	0.02096	0.01561	0.01344	0.00459	0.00142	
NOX MASS / MODE	LB	0.00011	0.01197	0.02946	0.28622	0.15812	0.00326	0.00011	0.48925
NOX MASS / RATED HP	LB/HP								0.00172
NOX- PERCENT OF EPA STANDARD									114.44
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.07723	0.06961	0.07327	0.07548	0.07488	0.06961	0.07723	0.07244 TA
DIFF. CALC & MEAS F/A	PERCENT	13.57	9.65	2.53	4.17	4.33	9.65	13.57	7.53 TA
DIFF EV & CB RATE	PERCENT	2.12	1.45	0.17	0.47	0.53	1.45	2.12	
SUM OF MOLE FRACTIONS		1.10485	1.03970	1.01381	1.02112	1.02555	1.03970	1.10485	

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6-285-B S/N 700106 TEST 5D LEANOUT 30 DEG BTC RUNS 48,51,56,64,72 10/02/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	3.000	5.550	1.047

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	48.	51.	56.	64.	72.	51.	48.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	7.40	13.00	120.00	95.00	55.00	13.00	7.40	
INDUCTION AIR FLOW (W)	LB/HR	110.00	207.00	1768.00	1390.00	835.00	207.00	110.00	
HYDROCARBON CONC.	PPM-C W	7500.00	1710.00	675.00	1095.00	1260.00	1710.00	7500.00	
OXIDES OF NITROGEN CONC	PPM W	37.00	193.75	2275.00	2175.00	1812.00	1937.50	37.00	
CARBON MONOXIDE CONC.	PERCENT	4.90	1.60	1.70	2.15	1.25	1.60	4.90	
CARBON DIOXIDE CONC.	PERCENT	10.80	13.00	13.00	12.85	13.20	13.00	10.80	
OXYGEN CONC.	PERCENT	1.38	0.50	0.25	0.25	0.38	0.90	1.38	
WET CORRECTION FACTOR	--	0.84725	0.84725	0.85137	0.84725	0.84725	0.84725	0.84725	
PROP. TORQUE	FT-LB	39.00	83.00	731.00	636.00	345.00	83.00	39.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.50	11.60	28.35	25.70	16.50	11.60	11.50	
INDUCTION AIR TEMP	DEG F	81.00	77.00	81.00	83.00	82.00	77.00	81.00	
COOLING AIR TEMP	DEG F	0.0	0.0	85.00	86.00	85.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	405.00	440.00	477.00	420.00	368.00	440.00	405.00	
EXHAUST GAS TEMP	DEG F	505.00	745.00	1505.00	1385.00	1222.00	745.00	505.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06800	0.06348	0.06860	0.06906	0.06658	0.06348	0.06800	0.06557 TA
IND. F/A EQUIV. RATIO	--	1.02	0.95	1.03	1.03	1.00	0.95	1.02	0.98 TA
ENGINE OBSERVED POWER	HP	4.46	14.22	278.37	217.97	114.30	14.22	4.46	
CBS BMEP	PSI	7.24	15.41	135.76	118.11	64.07	15.41	7.24	
CBS BSFC	LBM/BHP-HR	1.661	0.914	0.431	0.436	0.481	0.914	1.661	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	0.38723	0.17379	0.63116	0.79564	0.54931	0.17379	0.38723	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.08691	0.01222	0.00227	0.00365	0.00481	0.01222	0.08691	
HC MASS / MODE	LB	0.00645	0.03186	0.00316	0.06630	0.05493	0.00869	0.00645	0.17785
HC MASS / RATED HP	LB/HP								0.00062
HC - PERCENT OF EPA STANDARD									32.84
CO EMISSION RATE	LB/HR	4.32715	2.78127	27.31944	26.72021	9.32080	2.78127	4.32715	
BRAKE SPECIFIC CO	LBM/BHP-HR	0.97120	0.19555	0.09814	0.12258	0.08155	0.19555	0.97120	
CO MASS / MODE	LB	0.07212	0.50990	0.13660	2.22668	0.93208	0.13906	0.07212	4.08856
CO MASS / RATED HP	LB/HP								0.01435
CO - PERCENT OF EPA STANDARD									34.16
NOX EMISSION RATE	LB/HR	0.00633	0.06529	7.05357	5.24047	2.61945	0.65294	0.00633	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00142	0.00459	0.02534	0.02404	0.02292	0.04591	0.00142	
NOX MASS / MODE	LB	0.00011	0.01197	0.03527	0.43671	0.26195	0.03265	0.00011	0.77875
NOX MASS / RATED HP	LB/HP								0.00273
NOX- PERCENT OF EPA STANDARD									182.16

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.07723	0.06561	0.07003	0.07119	0.06903	0.06961	0.07723	0.07033 TA
DIFF. CALC & MEAS F/A	PERCENT	13.57	9.65	2.07	3.04	3.68	9.65	13.57	7.25 TA
DIFF EV & CB RATE	PERCENT	2.12	1.45	0.05	0.07	0.10	1.35	2.12	
SUM OF MOLE FRACTIONS		1.10485	1.03570	0.98530	0.99789	0.99013	1.04057	1.10485	

6-285-R S/N 700106 TEST 5E LEANOUT 30 DEG BTC RUNS 57-59,65-67 10/02/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	3.000 5.550	1.067

	UNITS	MODE 3	MODE 3	MODE 3	MODE 4	MODE 4	MODE 4	MODE 0
RUN NUMBER	--	57.	58.	59.	65.	66.	67.	
TIME IN MODE	MINUTES	0.30	0.30	0.30	5.00	5.00	5.00	
FUEL FLOW	LB/HR	115.00	110.00	105.00	90.00	85.00	80.00	
INDUCTION AIR FLOW (W)	LB/HR	1765.00	1770.00	1770.00	1390.00	1390.00	1400.00	
HYDROCARBON CONC.	PPM-C W	247.50	57.00	28.50	255.00	165.00	48.00	
OXIDES OF NITROGEN CONC	PPM W	2400.00	2500.00	2500.00	2450.00	2400.00	2000.00	
CARBON MONOXIDE CONC.	PERCENT	0.80	0.13	0.05	0.65	0.15	0.10	
CARBON DIOXIDE CONC.	PERCENT	13.60	13.40	12.90	13.60	13.25	12.00	
OXYGEN CONC.	PERCENT	0.38	1.00	2.00	0.50	1.25	3.13	
WET CORRECTION FACTOR	--	0.84982	0.85679	0.86273	0.85197	0.85580	0.87643	
PROP. TORQUE	FT-LB	720.00	700.00	665.00	620.00	599.00	540.00	
PROP. SPEED	RPM	2000.00	2000.00	2000.00	1800.00	1800.00	1800.00	
MFLD PRESSURE	IN HG ABS DRY	28.30	28.30	28.30	25.70	25.65	25.70	
INDUCTION AIR TEMP	DEG F	81.00	81.00	81.00	83.00	83.00	83.00	
COOLING AIR TEMP	DEG F	85.00	85.00	85.00	86.00	86.00	86.00	
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00	3.00	
MAX CYL HEAD TEMP	DEG F	473.00	458.00	440.00	413.00	398.00	379.00	
EXHAUST GAS TEMP	DEG F	1540.00	1528.00	1480.00	1420.00	1405.00	1346.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06586	0.06282	0.05996	0.06545	0.06181	0.05776	
IND. F/A EQUIV. RATIO	--	0.99	0.94	0.90	0.98	0.92	0.86	
ENGINE OBSERVED POWER	HP	274.18	266.56	253.24	212.49	205.29	185.07	
CBS BMEP	PSI	133.71	130.00	123.50	115.14	111.24	100.29	
CBS BSFC	LBM/BHP-HR	0.419	0.413	0.415	0.424	0.414	0.432	
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.22757	0.05300	0.02625	0.18494	0.11973	0.03548	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00083	0.00020	0.00010	0.00087	0.00058	0.00019	
HC MASS / MODE	LB	0.00114	0.00027	0.00013	0.01541	0.00998	0.00296	
CO EMISSION RATE	LB/HR	12.61953	2.09064	0.80218	8.10821	1.88051	1.30799	
BRAKE SPECIFIC CO	LBM/BHP-HR	0.04603	0.00784	0.00317	0.03816	0.00916	0.00707	
CO MASS / MODE	LB	0.06310	0.01045	0.00401	0.67568	0.15671	0.10900	
NOX EMISSION RATE	LB/HR	7.31741	7.70840	7.63639	5.89214	5.77489	4.90272	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.02669	0.02892	0.03016	0.02773	0.02813	0.02649	
NOX MASS / MODE	LB	0.03659	0.03854	0.03818	0.49101	0.48124	0.40856	
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.06753	0.06413	0.06090	0.06684	0.06346	0.05747	
DIFF. CALC & MEAS F/A	PERCENT	2.53	2.09	1.57	2.13	2.67	-0.50	
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	
SUM OF MOLE FRACTIONS		0.99148	0.97737	0.98425	0.98942	0.98153	0.97184	

6-285-B S/N 700106 TEST 5F BASELINE (30 DEG BTC) RUNS 73-77 10/02/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.209	68.00	62.50	2.1250	68.00	285.00	406.00	3.000 5.550	1.067

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	73.	74.	75.	76.	77.	74.	73.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	10.00	16.00	150.00	113.00	73.00	16.00	10.00	
INDUCTION AIR FLOW (W)	LB/HR	118.00	198.00	1770.00	1400.00	835.00	198.00	118.00	
HYDROCARBON CONC.	PPM-C W	16050.00	4500.00	1695.00	1800.00	2640.00	4500.00	16050.00	
OXIDES OF NITROGEN CONC	PPM W	13.25	62.50	315.00	425.00	185.00	62.50	13.25	
CARBON MONOXIDE CONC.	PERCENT	9.80	8.40	6.80	7.75	9.75	8.40	9.80	
CARBON DIOXIDE CONC.	PERCENT	8.10	9.35	9.55	10.05	8.85	9.35	8.10	
OXYGEN CONC.	PERCENT	1.13	0.63	0.13	0.13	0.13	0.63	1.13	
WET CORRECTION FACTOR	--	0.84725	0.84725	0.84763	0.84725	0.84819	0.84725	0.84725	
PROP. TORQUE	FT-LB	38.00	81.00	716.00	639.00	339.00	81.00	38.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	11.20	10.80	28.30	25.70	16.50	10.80	11.20	
INDUCTION AIR TEMP	DEG F	84.00	82.00	83.00	84.00	84.00	82.00	84.00	
COOLING AIR TEMP	DEG F	0.0	0.0	89.00	89.00	89.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	319.00	370.00	461.00	422.00	362.00	370.00	319.00	
EXHAUST GAS TEMP	DEG F	510.00	645.00	1341.00	1270.00	1076.00	645.00	510.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08566	0.08168	0.08566	0.08158	0.08837	0.08168	0.08566	0.08347 TA
IND. F/A EQUIV. RATIO	—	1.28	1.22	1.28	1.22	1.32	1.22	1.28	1.25 TA
ENGINE OBSERVED POWER	HP	4.34	13.88	272.66	219.00	112.31	13.88	4.34	
GBS BMEP	PSI	7.06	15.04	132.97	118.67	62.96	15.04	7.06	
GBS BSFC	LBM/BHP-HR	2.304	1.153	0.550	0.516	0.650	1.153	2.304	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	0.93828	0.45575	1.58533	1.30670	1.17793	0.45575	0.93828	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.21613	0.03283	0.00581	0.00597	0.01049	0.03283	0.21613	
HC MASS / MODE	LB	0.01564	0.08355	0.00793	0.10889	0.11779	0.02279	0.01564	0.37223
HC MASS / RATED HP	LB/HP								0.00131
HC - PERCENT OF EPA STANDARD									68.74
CO EMISSION RATE	LB/HR	9.79896	14.55096	140.83992	96.22823	74.49080	14.55096	9.79896	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.25720	1.04831	0.51654	0.43939	0.66325	1.04831	2.25720	
CO MASS / MODE	LB	0.16332	2.66768	0.70420	8.01902	7.44908	0.72755	0.16332	19.89413
CO MASS / RATED HP	LB/HP								0.06980
CO - PERCENT OF EPA STANDARD									166.20
NOX EMISSION RATE	LB/HR	0.00257	0.02099	0.97694	1.02305	0.27371	0.02099	0.00257	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00059	0.00151	0.00358	0.00467	0.00244	0.00151	0.00059	
NOX MASS / MODE	LB	0.00004	0.00385	0.00488	0.08525	0.02737	0.00105	0.00004	0.12249
NOX MASS / RATED HP	LB/HP								0.00043
NOX - PERCENT OF EPA STANDARD									28.65
** DATA VALIDITY CHECKS FOR ENGIO7 **									
CAL. FUEL AIR RATIO	LB/LB	0.09572	0.08642	0.08723	0.08468	0.09071	0.08642	0.09572	0.08773 TA
DIFF. CALC & MEAS F/A	PERCENT	11.75	5.80	1.84	3.79	2.65	5.80	11.75	5.11 TA
DIFF EV & CB RATE	PERCENT	1.40	0.67	0.05	0.47	0.05	0.67	1.40	
SUM OF MOLE FRACTIONS		1.10232	1.06576	1.04701	1.05117	1.04393	1.06576	1.10232	

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6-285-B S/N 700106 TEST 6 LEANOUT 15 DEG BTC RUNS 78-84 10/10/75

PBARC	TORY	TMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.180	82.00	68.00	2.1250	82.00	285.00	406.00	3.000 5.550	1.131

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
RUN NUMBER	--	78.	79.	80.	81.	82.	83.	84.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	11.00	0.30	0.30
FUEL FLOW	LB/HR	10.50	9.10	18.20	16.10	15.00	151.00	140.00
INDUCTION AIR FLOW (W)	LB/HR	128.00	125.00	235.00	220.00	230.00	1758.00	1755.00
HYDROCARBON CONC.	PPM-C W	12450.00	3600.00	3000.00	2535.00	1515.00	1350.00	1095.00
OXIDES OF NITROGEN CONC	PPM W	27.70	42.00	69.50	86.25	147.50	145.00	300.00
CARBON MONOXIDE CONC.	PERCENT	8.15	5.00	7.40	5.65	2.10	8.80	6.50
CARBON DIOXIDE CONC.	PERCENT	9.85	11.23	10.15	11.10	12.95	9.60	10.85
OXYGEN CONC.	PERCENT	1.62	0.88	0.45	0.45	0.38	0.0	0.0
WET CORRECTION FACTOR	--	0.84619	0.84619	0.84619	0.84619	0.84619	0.85011	0.84704
PROP. TORQUE	FT-LB	39.00	40.00	87.00	83.00	86.00	630.00	637.00
PROP. SPEED	RPM	600.00	600.00	900.00	900.00	900.00	2000.00	2000.00
MFLD PRESSURE	IN HG ABS DRY	12.40	12.40	12.00	12.30	12.80	28.30	28.30
INDUCTION AIR TEMP	DEG F	88.00	89.00	86.00	87.00	89.00	88.00	89.00
COOLING AIR TEMP	DEG F	0.0	0.0	0.0	0.0	0.0	95.00	95.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	3.00	3.00
MAX CYL HEAD TEMP	DEG F	351.00	407.00	370.00	418.00	455.00	418.00	432.00
EXHAUST GAS TEMP	DEG F	545.00	570.00	804.00	800.00	865.00	1475.00	1520.00
INDUCTION F/A RATIO (D)	LB/LB	0.08297	0.07363	0.07833	0.07402	0.06596	0.08688	0.08068
IND. F/A EQUIV. RATIO	--	1.24	1.10	1.17	1.11	0.99	1.30	1.21
ENGINE OBSERVED POWER	HP	4.46	4.57	14.91	14.22	14.74	239.91	242.57
CBS BMEP	PSI	7.24	7.43	16.16	15.41	15.97	117.00	118.30
CBS BSFC	LBM/BHP-HR	2.357	1.991	1.221	1.132	1.018	0.629	0.577

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
HC EMISSION RATE	LB/HR	0.77786	0.22789	0.35332	0.27735	0.17289	1.26676	1.81513
BRAKE SPECIFIC HC	LBM/BHP-HR	0.17459	0.04987	0.02370	0.01950	0.01173	0.00528	0.00418
HC MASS / MODE	LB	0.01296	0.00380	0.06478	0.05085	0.03170	0.00633	0.00508
CO EMISSION RATE	LB/HR	8.69856	5.40693	14.88796	10.55980	4.09386	141.71143	103.04181
BRAKE SPECIFIC CO	LBM/BHP-HR	1.95236	1.18322	0.99862	0.74244	0.27779	0.59069	0.42478
CO MASS / MODE	LB	0.14498	0.09012	2.72946	1.93596	0.75054	0.70856	0.51521
NOX EMISSION RATE	LB/HR	0.00574	0.00862	0.02714	0.03129	0.05582	0.45117	0.92222
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00129	0.00193	0.00182	0.00220	0.00379	0.00188	0.00380
NOX MASS / MODE	LB	0.00010	0.00015	0.00498	0.00574	0.01023	0.00226	0.00461

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
CAL. FUEL AIR RATIO	LB/LB	0.08572	0.07670	0.08334	0.07890	0.07089	0.08746	0.08153
DIFF. CALC & MEAS F/A	PERCENT	3.31	4.16	6.39	6.60	7.46	0.67	1.05
DIFF EV & CB RATE	PERCENT	0.44	0.49	0.99	1.09	1.15	0.05	0.05
SUM OF MOLE FRACTIONS		1.11824	1.04852	1.07563	1.06738	1.03840	1.04075	1.02870

6-285-B S/N 700106 TEST 6A LEANOUT 15 DEG BTC RUNS 85-91 10/10/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.180	82.00	68.00	2.1250	82.00	285.00	406.00	3.000	5.550	1.131

	UNITS	MODE 3	MODE 3	MODE 3	MODE 4	MODE 4	MODE 4	MODE 4
RUN NUMBER	--	85.	86.	87.	88.	89.	90.	91.
TIME IN MODE	MINUTES	0.30	0.30	0.30	5.00	5.00	5.00	5.00
FUEL FLOW	LB/HR	130.00	120.00	115.00	113.00	105.00	100.00	95.00
INDUCTION AIR FLOW (W)	LB/HR	1755.00	1755.00	1755.00	1370.00	1370.00	1370.00	1370.00
HYDROCARBON CONC.	PPM-C W	810.00	318.00	44.25	1440.00	1140.00	900.00	405.00
OXIDES OF NITROGEN CONC	PPM W	570.00	1350.00	1650.00	215.00	465.00	76.00	1350.00
CARBON MONOXIDE CONC.	PERCENT	5.95	1.85	0.65	7.75	4.75	3.10	1.45
CARBON DIOXIDE CONC.	PERCENT	11.95	12.95	13.70	10.25	11.65	12.50	13.40
OXYGEN CONC.	PERCENT	0.0	0.0	0.25	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.84619	0.84786	0.85077	0.84619	0.85126	0.85215	0.85482
PROP. TORQUE	FT-LB	630.00	617.00	590.00	568.00	565.00	562.00	552.00
PROP. SPEED	RPM	2000.00	2000.00	2000.00	1800.00	1800.00	1800.00	1800.00
MFLD PRESSURE	IN HG ABS DRY	28.30	28.30	28.30	25.70	25.70	25.70	25.70
INDUCTION AIR TEMP	DEG F	90.00	90.00	90.00	89.00	89.00	89.00	89.00
COOLING AIR TEMP	DEG F	95.00	95.00	95.00	95.00	95.00	95.00	95.00
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00	3.00	3.00
MAX CYL HEAD TEMP	DEG F	443.00	458.00	465.00	408.00	419.00	421.00	426.00
EXHAUST GAS TEMP	DEG F	1569.00	1635.00	1675.00	1390.00	1445.00	1478.00	1538.00
INDUCTION F/A RATIO (D)	LB/LB	0.07492	0.06916	0.06628	0.08343	0.07752	0.07383	0.07014
IND. F/A EQUIV. RATIO	--	1.12	1.03	0.99	1.25	1.16	1.10	1.09
ENGINE OBSERVED POWER	HP	239.91	234.96	224.68	194.67	193.64	192.61	189.19
OBS BMEP	PSI	117.00	114.59	109.57	105.49	104.93	104.37	102.51
OBS BSFC	LBM/BHP-HR	0.542	0.511	0.512	0.580	0.542	0.519	0.502

CARBON BALANCE MASS EMISSIONS

	UNITS							
HC EMISSION RATE	LB/HR	0.67795	0.29739	0.04089	1.03758	0.83381	0.65929	0.29821
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00283	0.00127	0.00018	0.00533	0.00431	0.00342	0.00157
HC MASS / MODE	LB	0.00339	0.00149	0.00020	0.08647	0.06948	0.05494	0.02468
CO EMISSION RATE	LB/HR	85.07156	25.61333	10.30616	95.39297	59.70384	39.06627	18.30109
BRAKE SPECIFIC CO	LBM/BHP-HR	0.35460	0.12604	0.04587	0.49003	0.30832	0.20282	0.09674
CO MASS / MODE	LB	0.42536	0.14807	0.05153	7.94941	4.97532	3.25552	1.52509
NOX EMISSION RATE	LB/HR	1.58196	4.18642	5.05096	0.51369	1.12777	0.18461	3.27406
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00659	0.01782	0.02248	0.00264	0.00582	0.00096	0.01731
NOX MASS / MODE	LB	0.00791	0.02093	0.02525	0.04281	0.09398	0.01538	0.27284

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS							
CAL. FUEL AIR RATIO	LB/LB	0.07932	0.07096	0.06749	0.08468	0.07762	0.07387	0.07010
DIFF. CALC & MEAS F/A	PERCENT	5.87	2.60	1.84	1.51	0.13	0.05	-0.05
DIFF EV & CB RATE	PERCENT	1.47	0.05	0.05	0.09	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.11601	0.97825	0.98275	1.04302	1.00598	0.95079	0.97997

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6-285-B S/N 700106 TEST 6B LEANOUT 15 DEG BTC RUNS 92-95 10/10/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.180	82.00	68.00	2.1250	82.00	285.00	406.00	3.000 5.550	1.131

	UNITS	MODE 4	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	92.	93.	94.	95.			
TIME IN MODE	MINUTES	5.00	6.00	6.00	6.00			
FUEL FLOW	LB/HR	90.00	80.00	70.00	65.00			
INDUCTION AIR FLOW (W)	LB/HR	1370.00	890.00	890.00	890.00			
HYDROCARBON CONC.	PPM-C W	33.75	2010.00	1605.00	1110.00			
OXIDES OF NITROGEN CONC	PPM W	1575.00	130.00	365.00	780.00			
CARBON MONOXIDE CONC.	PERCENT	0.40	9.50	5.30	2.40			
CARBON DIOXIDE CONC.	PERCENT	13.75	9.25	11.30	12.65			
OXYGEN CONC.	PERCENT	0.25	0.13	0.13	0.13			
WET CORRECTION FACTOR	--	0.85517	0.85944	0.85542	0.86305			
PROP. TORQUE	FT-LB	540.00	350.00	345.00	350.00			
PROP. SPEED	RPM	1800.00	1740.00	1740.00	1740.00			
MFLD PRESSURE	IN HG ABS DRY	25.70	18.10	17.70	18.10			
INDUCTION AIR TEMP	DEG F	89.00	88.00	88.00	88.00			
COOLING AIR TEMP	DEG F	95.00	94.00	94.00	94.00			
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00			
MAX CYL HEAD TEMP	DEG F	430.00	358.00	370.00	383.00			
EXHAUST GAS TEMP	DEG F	1574.00	1222.00	1272.00	1348.00			
INDUCTION F/A RATIO (D)	LB/LB	0.06644	0.09092	0.07955	0.07387			
IND. F/A EQUIV. RATIO	--	0.99	1.36	1.19	1.11			
ENGINE OBSERVED POWER	HP	185.07	115.96	114.30	115.96			
CBS BMEP	PSI	100.29	65.00	64.07	65.00			
CBS BSFC	LBM/BHP-HR	0.486	0.690	0.612	0.561			

CARBON BALANCE MASS EMISSIONS

HC EMISSION RATE	LB/HR	0.02460	0.96626	0.76703	0.53998
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00013	0.00833	0.00671	0.00466
HC MASS / MODE	LB	0.00205	0.09663	0.07670	0.05400
CO EMISSION RATE	LB/HR	5.03408	79.23625	43.74010	20.34172
BRAKE SPECIFIC CO	LBM/BHP-HR	0.02720	0.68333	0.38268	0.17543
CO MASS / MODE	LB	0.41951	7.92362	4.37401	2.03417
NOX EMISSION RATE	LB/HR	3.80722	0.20723	0.57841	1.25822
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.02057	0.00179	0.00506	0.01085
NOX MASS / MODE	LB	0.31727	0.02072	0.05784	0.12582

** DATA VALIDITY CHECKS FOR ENG107 **

CAL. FUEL AIR RATIO	LB/LB	0.06698	0.08913	0.07873	0.07215
DIFF. CALC & MEAS F/A	PERCENT	0.81	-1.96	-1.03	-2.33
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		0.97217	1.04340	1.00802	0.97046

6-285-B S/N 700106 TEST 7 LEANOUT 40 DEG BTC RUNS 96-102 12/01/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.245	53.00	43.00	2.1250	53.00	285.00	406.00	3.000	5.590	0.357

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
RUN NUMBER	--	96.	97.	98.	99.	100.	101.	102.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	11.00	0.30	0.30
FUEL FLOW	LB/HR	10.40	8.00	15.80	12.40	13.80	155.00	145.00
INDUCTION AIR FLOW (W)	LB/HR	115.00	115.00	190.00	190.00	190.00	1760.00	1755.00
HYDROCARBON CONC.	PPM-C W	33750.00	13200.00	5850.00	3075.00	4380.00	2295.00	1920.00
OXIDES OF NITROGEN CONC	PPM W	9.00	43.00	73.00	295.00	180.00	275.00	520.00
CARBON MONOXIDE CONC.	PERCENT	9.40	4.30	9.60	2.43	5.77	10.15	8.18
CARBON DIOXIDE CONC.	PERCENT	6.95	10.75	9.03	12.85	11.20	8.95	10.15
OXYGEN CONC.	PERCENT	3.13	2.38	0.50	0.38	0.37	0.0	0.0
WET CORRECTION FACTOR	--	0.85875	0.85875	0.85875	0.8 875	0.85875	0.85875	0.85875
PROP. TORQUE	FT-LB	39.00	39.00	89.00	90.00	93.00	739.00	740.00
PROP. SPEED	RPM	600.00	600.00	900.00	900.00	900.00	2000.00	2000.00
HELD PRESSURE	IN HG ABS DRY	11.00	11.40	10.80	11.20	10.90	28.20	28.15
INDUCTION AIR TEMP	DEG F	0.0	58.00	58.00	58.00	58.00	59.00	60.00
COOLING AIR TEMP	DEG F	68.00	0.0	0.0	0.0	0.0	63.00	63.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	3.00	3.00
MAX CYL HEAD TEMP	DEG F	281.00	366.00	384.00	406.00	413.00	467.00	486.00
EXHAUST GAS TEMP	DEG F	410.00	442.00	580.00	650.00	618.00	1275.00	1322.00
INDUCTION F/A RATIO (D)	LB/LB	0.09076	0.06581	0.08346	0.06550	0.07289	0.08838	0.08292
IND. F/A EQUIV. RATIO	--	1.36	1.04	1.25	0.98	1.09	1.32	1.24
ENGINE OBSERVED POWER	HP	4.46	4.46	15.25	15.42	15.94	281.42	281.80
CBS BMEP	PSI	7.24	7.24	16.53	16.71	17.27	137.24	137.43
CBS BSFC	LBM/BHP-HR	2.334	1.796	1.036	0.804	0.866	0.551	0.515

CARBON BALANCE MASS EMISSIONS

HC EMISSION RATE	LB/HR	1.97596	0.72683	0.54644	0.27837	0.39478	2.09695	1.71310
BRAKE SPECIFIC HC	LBM/BHP-HR	0.44345	0.16313	0.03583	0.01805	0.02477	0.00745	0.00608
HC MASS / MODE	LB	0.03293	0.01211	0.10018	0.05103	0.07238	0.01048	0.00857
CO EMISSION RATE	LB/HR	9.54083	4.10471	15.54583	3.81364	9.01587	160.77737	126.52866
BRAKE SPECIFIC CO	LBM/BHP-HR	2.14139	0.92128	1.01931	0.24727	0.56573	0.57131	0.44901
CO MASS / MODE	LB	0.15901	0.06841	2.85007	0.69917	1.65291	0.80389	0.63264
NOX EMISSION RATE	LB/HR	0.00175	0.00785	0.02261	0.08855	0.05380	0.83319	1.53848
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00039	0.00176	0.00148	0.00574	0.00338	0.00296	0.00546
NOX MASS / MODE	LB	0.00003	0.00013	0.00415	0.01623	0.00986	0.00417	0.00769

** DATA VALIDITY CHECKS FOR ENG107 **

CAL. FUEL AIR RATIO	LB/LB	0.09876	0.07570	0.09028	0.07236	0.08028	0.09151	0.08582
DIFF. CALC & MEAS F/A	PERCENT	8.82	8.43	8.17	10.48	10.14	3.54	3.50
DIFF EV & CB RATE	PERCENT	0.22	1.08	1.37	1.94	2.01	0.50	0.73
SUM OF MOLE FRACTIONS		1.07858	1.08667	1.10980	1.07283	1.10674	1.07129	1.07307

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6-285-B S/N 700106 TEST 7A LEANOUT 40 DEG BTC RUNS 103-109 12/01/75

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
IN HG ABS 30.245	DEG F 53.00	DEG F 43.00	2.1250	DEG F 53.00	285.00	406.00	3.000 5.550	0.357

	UNITS	MODE 3	MODE 3	MODE 3	MODE 3	MODE 3	MODE 4	MODE 4
RUN NUMBER	--	103.	104.	105.	106.	107.	108.	109.
TIME IN MODE	MINUTES	0.30	0.30	0.30	0.30	0.30	5.00	5.00
FUEL FLOW	LB/HR	135.00	115.00	105.00	95.00	90.00	117.00	105.00
INDUCTION AIR FLOW (W)	LB/HR	1765.00	1760.00	1760.00	1760.00	1810.00	1415.00	1410.00
HYDROCARBON CONC.	PPM-C W	1620.00	690.00	172.00	162.00	151.00	1905.00	1585.00
OXIDES OF NITROGEN CONC	PPM W	925.00	3200.00	3650.00	3420.00	2430.00	455.00	1225.00
CARBON MONOXIDE CONC.	PERCENT	6.05	1.20	0.20	0.18	0.19	8.80	5.30
CARBON DIOXIDE CONC.	PERCENT	11.20	13.30	12.75	11.65	11.00	9.65	11.50
OXYGEN CONC.	PERCENT	0.0	0.38	2.08	3.75	4.88	0.0	0.0
WET CORRECTION FACTOR	--	0.85875	0.85875	0.87204	0.87704	0.87430	0.85875	0.85875
PROP. TORQUE	FT-LB	749.00	730.00	676.00	620.00	567.00	624.00	630.00
PROP. SPEED	RPM	2000.00	2000.00	2000.00	2000.00	2000.00	1800.00	1800.00
FIELD PRESSURE	IN HG ABS DRY	28.15	28.10	28.10	28.10	28.15	25.70	25.70
INDUCTION AIR TEMP	DEG F	62.00	64.00	65.00	65.00	63.00	64.00	65.00
COOLING AIR TEMP	DEG F	63.00	64.00	63.00	63.00	64.00	65.00	65.00
COOLING AIR DELTA P	IN H2O	3.00	4.00	4.00	3.00	3.00	3.00	3.00
MAX CYL HEAD TEMP	DEG F	504.00	500.00	450.00	414.00	376.00	445.00	459.00
EXHAUST GAS TEMP	DEG F	1368.00	1450.00	1395.00	1330.00	1298.00	1218.00	1280.00
INDUCTION F/A RATIO (D)	LB/LB	0.07676	0.06558	0.05987	0.05417	0.04990	0.08298	0.07474
IND. F/A EQUIV. RATIO	--	1.15	0.98	0.90	0.81	0.75	1.24	1.12
ENGINE OBSERVED POWER	HP	285.22	277.99	257.43	236.10	215.92	213.86	215.92
CBS BMEP	PSI	139.10	135.57	125.54	115.14	105.30	115.89	117.00
CBS BSFC	LBM/BHP-HR	0.473	0.414	0.408	0.402	0.417	0.547	0.486

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CARBON BALANCE MASS EMISSIONS

HC EMISSION RATE	LB/HR	1.43178	0.62133	0.15655	0.14520	0.13598	1.36281	1.04882
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00502	0.00224	0.00061	0.00061	0.00063	0.00637	0.00486
HC MASS / MODE	LB	0.00716	0.00311	0.00078	0.00073	0.00068	0.11357	0.08740
CO EMISSION RATE	LB/HR	92.69827	18.73296	3.20467	2.85647	3.01989	109.13826	64.89388
BRAKE SPECIFIC CO	LBM/BHP-HR	0.32500	0.06739	0.01245	0.01210	0.01399	0.51032	0.30055
CO MASS / MODE	LB	0.46349	0.09366	0.01602	0.01428	0.01510	9.09485	5.40782
NOX EMISSION RATE	LB/HR	2.71088	9.55493	11.01621	10.16441	7.25615	1.07934	2.86891
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00950	0.03437	0.04279	0.04305	0.03361	0.00505	0.01329
NOX MASS / MODE	LB	0.01355	0.04777	0.05508	0.05082	0.03628	0.08994	0.23908

** DATA VALIDITY CHECKS FOR ENG107 **

CAL. FUEL AIR RATIO	LB/LB	0.08063	0.06857	0.06103	0.05584	0.05247	0.08767	0.07893
DIFF. CALC & MEAS F/A	PERCENT	5.04	4.57	1.93	3.08	5.15	5.65	5.61
DIFF EV & CB RATE	PERCENT	1.05	0.41	0.05	0.05	0.05	1.03	1.10
SUM OF MOLE FRACTIONS		1.06542	1.00453	0.98756	0.99466	1.00931	1.07933	1.05730

6-285-B S/N 700106 TEST 7B LEANOUT 40 DEG BTC RUNS 110-116 12/01/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.245	53.00	43.00	2.1250	53.00	285.00	406.00	3.000	5.550	0.357

	UNITS	MODE 4	MODE 4	MODE 4	MODE 5	MODE 5	MODE 5	MODE 5
RUN NUMBER	--	110.	111.	112.	113.	114.	115.	116.
TIME IN MODE	MINUTES	5.00	5.00	5.00	6.00	6.00	6.00	6.00
FUEL FLOW	LB/HR	90.00	80.00	75.00	75.00	65.00	60.00	55.00
INDUCTION AIR FLOW (W)	LB/HR	1405.00	1405.00	1430.00	830.00	830.00	830.00	830.00
HYDROCARBON CONC.	PPM-C W	420.00	337.50	285.00	3075.00	2385.00	2130.00	1755.00
OXIDES OF NITROGEN CONC	PPM W	3350.00	3350.00	2650.00	255.00	923.00	1650.00	3000.00
CARBON MONOXIDE CONC.	PERCENT	0.85	0.19	0.20	10.45	6.25	4.15	0.90
CARBON DIOXIDE CONC.	PERCENT	13.40	12.30	11.10	8.55	11.00	12.05	13.25
OXYGEN CONC.	PERCENT	0.45	2.75	4.63	0.0	0.0	0.0	0.38
WET CORRECTION FACTOR	--	0.85875	0.87090	0.88716	0.85875	0.85875	0.85875	0.85990
PROP. TORQUE	FT-LB	619.00	568.00	530.00	337.00	342.00	343.00	342.00
PROP. SPEED	RPM	1800.00	1800.00	1800.00	1725.00	1730.00	1740.00	1730.00
MFLD PRESSURE	IN HG ABS DRY	25.70	25.60	25.70	16.50	16.50	16.50	16.50
INDUCTION AIR TEMP	DEG F	65.00	65.00	65.00	64.00	64.00	64.00	64.00
COOLING AIR TEMP	DEG F	65.00	65.00	66.00	63.00	63.00	63.00	63.00
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00	3.00	3.00
MAX CYL HEAD TEMP	DEG F	466.00	425.00	377.00	350.00	367.00	378.00	384.00
EXHAUST GAS TEMP	DEG F	1350.00	1282.00	1210.00	1020.00	1090.00	1125.00	1162.00
INDUCTION F/A RATIO (D)	LB/LB	0.06429	0.05714	0.05264	0.09069	0.07859	0.07255	0.06650
IND. F/A EQUIV. RATIO	--	0.96	0.85	0.79	1.36	1.18	1.09	0.99
ENGINE OBSERVED POWER	HP	212.15	194.67	181.65	110.69	112.45	113.64	112.45
CBS BMEP	PSI	114.96	105.49	98.43	62.59	63.51	63.70	63.51
CBS BSFC	LBM/BHP-HR	0.424	0.411	0.413	0.678	0.577	0.528	0.488
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.30181	0.24260	0.20845	1.36015	1.00976	0.88707	0.76670
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00142	0.00125	0.00115	0.01229	0.00896	0.00781	0.00681
HC MASS / MODE	LB	0.02515	0.02022	0.01737	0.13601	0.10098	0.08871	0.07667
CO EMISSION RATE	LB/HR	10.58897	2.40122	2.61984	80.13289	45.87364	29.96269	6.82535
BRAKE SPECIFIC CO	LBM/BHP-HR	0.04991	0.01233	0.01442	0.72396	0.40721	0.26367	0.06059
CO MASS / MODE	LB	0.88241	0.20010	0.21832	8.01328	4.58736	2.99627	0.68253
NOX EMISSION RATE	LB/HR	7.98238	7.98500	6.42699	0.37401	1.29580	2.27860	4.34585
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.03763	0.04102	0.03538	0.00338	0.01150	0.02005	0.03858
NOX MASS / MODE	LB	0.66520	0.66542	0.53558	0.03740	0.12958	0.22786	0.43459
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.06750	0.05903	0.05327	0.09333	0.08161	0.07676	0.06858
DIFF. CALC & MEAS F/A	PERCENT	4.99	3.31	1.21	2.91	3.84	5.80	3.13
DIFF EV & CB RATE	PERCENT	0.42	0.05	0.05	0.18	0.75	1.06	0.05
SUM OF MOLE FRACTIONS		1.00092	0.99268	0.99206	1.05096	1.05188	1.04589	0.97828

6-285-B S/N 700106 TEST 8 LEANOUT 45 DEG BTC RUNS 117-123 12/17/75

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.034	57.50	55.00	2.1250	57.50	285.00	406.00	3.000	5.550	0.850

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 3	MODE 3	MODE 3
RUN NUMBER	--	117.	118.	119.	120.	121.	122.	123.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	0.30	0.30	0.30
FUEL FLOW	LB/HR	10.80	7.00	15.80	12.10	154.00	134.00	105.00
INDUCTION AIR FLOW (W)	LB/HR	110.00	100.00	190.00	185.00	1790.00	1775.00	1780.00
HYDROCARBON CONC.	PPM-C W	37500.00	18300.00	5850.00	2475.00	2250.00	1530.00	270.00
OXIDES OF NITROGEN CONC	PPM W	8.00	38.50	64.00	290.00	305.00	1225.00	3500.00
CARBON MONOXIDE CONC.	PERCENT	9.85	3.85	9.50	2.05	10.05	5.30	0.25
CARBON DIOXIDE CONC.	PERCENT	6.65	10.45	8.85	12.85	8.95	11.40	12.85
OXYGEN CONC.	PERCENT	4.00	2.62	0.63	0.50	0.0	0.0	1.75
WET CORRECTION FACTOR	--	0.88392	0.85077	0.85077	0.85077	0.85077	0.85077	0.85609
PROP. TORQUE	FT-LB	34.00	31.00	81.00	81.00	691.00	711.00	675.00
PROP. SPEED	RPM	600.00	600.00	900.00	900.00	2000.00	2000.00	2000.00
MFLD PRESSURE	IN HG ABS DRY	11.00	11.00	10.80	10.90	28.30	28.35	28.30
INDUCTION AIR TEMP	DEG F	61.00	62.00	62.00	63.00	67.00	68.00	68.00
COOLING AIR TEMP	DEG F	0.0	0.0	0.0	0.0	66.00	68.00	67.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	5.20	8.00	5.20
MAX CYL HEAD TEMP	DEG F	285.00	352.00	382.00	409.00	448.00	448.00	450.00
EXHAUST GAS TEMP	DEG F	420.00	403.00	575.00	648.00	1252.00	1332.00	1395.00
INDUCTION F/A RATIO (D)	LB/LB	0.09902	0.07060	0.08387	0.06597	0.08677	0.07614	0.05949
IND. F/A EQUIV. RATIO	--	1.48	1.06	1.25	0.99	1.30	1.14	0.89
ENGINE OBSERVED POWER	HP	3.88	3.54	13.88	13.88	263.14	270.75	257.04
OBS BMEP	PSI	6.31	5.76	15.04	15.04	128.33	132.04	125.36
OBS BSFC	LBM/BHP-HR	2.780	1.977	1.138	0.872	0.585	0.495	0.408
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	2.16567	0.89733	0.55949	0.22718	2.07272	1.39966	0.24726
BRAKE SPECIFIC HC	LBM/BHP-HR	0.55755	0.25338	0.04031	0.01637	0.00788	0.00517	0.00096
HC MASS / MODE	LB	0.03609	0.01496	0.10257	0.04165	0.01036	0.00700	0.00124
CO EMISSION RATE	LB/HR	10.15067	3.24237	15.60499	3.23184	159.01018	83.27367	3.95648
BRAKE SPECIFIC CO	LBM/BHP-HR	2.61330	0.91553	1.12424	0.23283	0.60429	0.30756	0.01539
CO MASS / MODE	LB	0.16918	0.05404	2.86092	0.59250	0.79505	0.41637	0.01978
NOX EMISSION RATE	LB/HR	0.00153	0.00626	0.02030	0.08827	0.93168	3.71599	10.62759
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00039	0.00177	0.00146	0.00636	0.00354	0.01372	0.04135
NOX MASS / MODE	LB	0.00003	0.00010	0.00372	0.01618	0.00466	0.01858	0.05314
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09781	0.07710	0.08997	0.07094	0.09133	0.07905	0.06217
DIFF. CALC & MEAS F/A	PERCENT	-1.22	9.20	7.27	7.54	5.25	3.83	4.50
DIFF EV & CB RATE	PERCENT	0.05	0.84	0.97	1.14	0.71	0.57	0.05
SUM OF MOLE FRACTIONS		1.08111	1.06055	1.08865	1.03658	1.07654	1.03523	0.99038

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6-285-B S/N 700106 TEST 8A LEANOUT 45 DEG BTC RUNS 124-130 12/17/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIC	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.034	57.50	55.00	2.1250	57.50	285.00	406.00	3.000	5.550	0.850

	UNITS	MODE 3	MODE 3	MODE 4	MODE 4	MODE 4	MODE 4	MODE 5
RUN NUMBER	--	124.	125.	126.	127.	128.	129.	130.
TIME IN MODE	MINUTES	0.30	0.30	5.00	5.00	5.00	5.00	6.00
FUEL FLOW	LB/HR	90.00	85.00	119.00	90.00	75.00	70.00	75.00
INDUCTION AIR FLOW (W)	LB/HR	1810.00	1810.00	1420.00	1410.00	1430.00	1460.00	850.00
HYDROCARBON CONC.	PPM-C W	225.00	470.00	1950.00	780.00	412.00	750.00	3000.00
OXIDES OF NITROGEN CONC	PPM W	1900.00	875.00	385.00	3300.00	2800.00	1125.00	260.00
CARBON MONOXIDE CONC.	PERCENT	0.20	0.20	9.35	0.70	0.18	0.24	10.35
CARBON DIOXIDE CONC.	PERCENT	10.56	10.15	9.35	13.40	11.20	10.15	8.55
OXYGEN CONC.	PERCENT	5.37	6.25	0.0	0.64	4.62	5.87	0.13
WET CORRECTION FACTOR	--	0.88331	0.88228	0.85077	0.85134	0.88077	0.88188	0.85077
PROP. TORQUE	FT-LB	562.00	510.00	610.00	619.00	535.00	477.00	335.00
PROP. SPEED	RPM	2000.00	2000.00	1800.00	1800.00	1800.00	1800.00	1715.00
MFLD PRESSURE	IN HG ABS DRY	28.20	28.15	25.70	25.70	25.70	25.60	16.50
INDUCTION AIR TEMP	DEG F	68.00	68.00	68.00	68.00	67.00	67.00	66.00
COOLING AIR TEMP	DEG F	66.00	66.00	66.00	66.00	66.00	66.00	66.00
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00	3.00	3.00
MAX CYL HEAD TEMP	DEG F	382.00	360.00	455.00	472.00	397.00	342.00	368.00
EXHAUST GAS TEMP	DEG F	1272.00	1253.00	1200.00	1335.00	1220.00	0.0	0.0
INDUCTION F/A RATIO (D)	LB/LB	0.05015	0.04736	0.08452	0.06438	0.05290	0.04836	0.08899
IND. F/A EQUIV. RATIO	--	0.75	0.71	1.26	0.96	0.79	0.72	1.33
ENGINE OBSERVED POWER	HP	214.01	194.21	209.06	212.15	183.36	183.44	109.39
OBS BMEP	PSI	104.37	94.71	113.29	114.96	99.36	88.59	62.21
OBS BSFC	LBM/BHP-HR	0.421	0.438	0.569	0.424	0.409	0.428	0.686
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.20839	0.42672	1.41268	0.56965	0.30101	0.55719	1.34675
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00097	0.00220	0.00676	0.00269	0.00164	0.00341	0.01231
HC MASS / MODE	LB	0.00104	0.00213	0.11772	0.04747	0.02508	0.04643	0.13468
CO EMISSION RATE	LB/HR	3.30316	3.23426	116.33800	8.78626	2.33833	3.17431	79.80080
BRAKE SPECIFIC CO	LBM/BHP-HR	0.01543	0.01665	0.55647	0.04142	0.01275	0.01942	0.72950
CO MASS / MODE	LB	0.01652	0.01617	9.69483	0.73219	0.19486	0.26453	7.98008
NOX EMISSION RATE	LB/HR	5.83524	2.63430	0.92486	7.99166	6.78340	2.77142	0.38703
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.02727	0.01356	0.00442	0.03767	0.03700	0.01695	0.00354
NOX MASS / MODE	LB	0.02918	0.01317	0.07707	0.66597	0.56528	0.23095	0.03870
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.05091	0.04854	0.08918	0.06681	0.05341	0.04965	0.09258
DIFF. CALC & MEAS F/A	PERCENT	1.51	2.48	5.51	3.79	0.97	2.68	4.04
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.85	0.05	0.05	0.05	0.27
SUM OF MOLE FRACTIONS		0.99071	1.00534	1.07767	0.99220	0.99637	0.99204	1.05722

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6-285-8 S/N 700106 TEST 88 LEANOUT 45 DEG BTC RUNS 131-133 12/17/75

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.034	57.50	55.00	2.1250	57.50	285.00	406.00	3.000	5.550	0.850

	UNITS	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	131.	132.	133.				
TIME IN MODE	MINUTES	6.00	6.00	6.00				
FUEL FLOW	LB/HR	65.00	55.00	50.00				
INDUCTION AIR FLOW (W)	LB/HR	840.00	840.00	840.00				
HYDROCARBON CONC.	PPM-C W	2310.00	1860.00	990.00				
OXIDES OF NITROGEN CONC	PPM W	830.00	3000.00	3300.00				
CARBON MONOXIDE CONC.	PERCENT	6.60	1.35	0.20				
CARBON DIOXIDE CONC.	PERCENT	10.75	13.20	13.00				
OXYGEN CONC.	PERCENT	0.13	0.38	1.62				
WET CORRECTION FACTOR	--	0.85077	0.85077	0.85420				
PROP. TORQUE	FT-LB	340.00	340.00	332.00				
PROP. SPEED	RPM	1725.00	1725.00	1700.00				
MFLD PRESSURE	IN HG ABS DRY	16.50	16.50	16.50				
INDUCTION AIR TEMP	DEG F	66.00	66.00	66.00				
COOLING AIR TEMP	DEG F	66.00	66.00	66.00				
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00				
MAX CYL HEAD TEMP	DEG F	385.00	399.00	392.00				
EXHAUST GAS TEMP	DEG F	0.0	0.0	0.0				
INDUCTION F/A RATIO (D)	LB/LB	0.07804	0.06604	0.06003				
IND. F/A EQUIV. RATIO	--	1.17	0.99	0.90				
ENGINE OBSERVED POWER	HP	111.67	111.67	107.48				
CBS BMEP	PSI	63.14	63.14	61.66				
CBS BSFC	LBM/BHP-HR	0.582	0.493	0.465				
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.98192	0.79823	0.42668				
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00879	0.00715	0.00397				
HC MASS / MODE	LB	0.09819	0.07982	0.04267				
CO EMISSION RATE	LB/HR	48.18471	9.95066	1.48636				
BRAKE SPECIFIC CO	LBM/BHP-HR	0.43149	0.08911	0.01383				
CO MASS / MODE	LB	4.81847	0.99507	0.14864				
NOX EMISSION RATE	LB/HR	1.16990	4.26919	4.71595				
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.01048	0.03823	0.04388				
NOX MASS / MODE	LB	0.11699	0.42692	0.47160				
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.08202	0.06955	0.06288				
DIFF. CALC & MEAS F/A	PERCENT	5.09	5.32	4.74				
DIFF EV & CB RATE	PERCENT	0.86	0.47	0.05				
SUM OF MOLE FRACTIONS		1.06156	1.00824	0.99273				

6-285-8 S/N 700106 TEST 9 LEANOUT 50 DEG BTC RUNS 134-140 01/06/76

F-24

PBARO	TDRY	TMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.124	67.00	65.00	2.1250	67.00	285.00	406.00	3.000 5.550	1.255

	UNITS	MODE 1	MODE 2	MODE 2	MODE 3	MODE 3	MODE 3	MODE 3
RUN NUMBER	--	134.	135.	136.	137.	138.	139.	140.
TIME IN MODE	MINUTES	1.00	11.00	11.00	0.30	0.30	0.30	0.30
FUEL FLOW	LB/HR	10.60	15.80	11.80	153.00	130.00	100.00	90.10
INDUCTION AIR FLOW (W)	LB/HR	118.00	190.00	192.00	1720.00	1710.00	1745.00	1760.00
HYDROCARBON CONC.	PPM-C W	28500.00	6150.00	3375.00	2025.00	1350.00	337.50	322.50
OXIDES OF NITROGEN CONC	PPM W	12.00	62.50	290.00	320.00	1312.00	3100.00	3050.00
CARBON MONOXIDE CONC.	PERCENT	8.65	9.50	1.70	9.85	5.00	0.15	0.15
CARBON DIOXIDE CONC.	PERCENT	7.55	9.05	12.85	9.05	11.65	12.40	11.10
OXYGEN CONC.	PERCENT	3.25	0.50	0.75	0.13	0.13	2.50	4.62
WET CORRECTION FACTOR	--	0.86386	0.84417	0.84417	0.85201	0.84625	0.86014	0.87097
PROP. TORQUE	FT-LB	38.00	85.00	84.00	667.00	680.00	640.00	595.00
PROP. SPEED	RPM	600.00	900.00	900.00	2000.00	2000.00	2000.00	2000.00
MFLD PRESSURE	IN HG ABS DRY	11.00	10.50	11.00	28.30	28.30	28.20	28.20
INDUCTION AIR TEMP	DEG F	68.00	68.00	70.00	76.00	76.00	76.00	75.00
COOLING AIR TEMP	DEG F	0.0	0.0	72.00	78.00	78.00	80.00	76.80
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	8.20	8.80	7.10	4.90
MAX CYL HEAD TEMP	DEG F	285.00	377.00	424.00	458.00	480.00	418.00	377.00
EXHAUST GAS TEMP	DEG F	428.00	572.00	680.00	1260.00	1354.00	1350.00	1268.00
INDUCTION F/A RATIO (D)	LB/LB	0.09097	0.08421	0.06224	0.09008	0.07699	0.05803	0.05184
IND. F/A EQUIV. RATIO	--	1.36	1.26	0.93	1.35	1.15	0.87	0.78
ENGINE OBSERVED POWER	HP	4.34	14.57	14.39	254.00	258.95	243.72	226.58
OBS BMEP	PSI	7.06	15.79	15.60	123.87	126.29	118.86	110.50
OBS BSFC	LBM/BHP-HR	2.442	1.085	0.820	0.602	0.502	0.410	0.398

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 2	MODE 3	MODE 3	MODE 3	MODE 3
HC EMISSION RATE	LB/HR	1.75834	0.58538	0.30938	1.86292	1.20957	0.30557	0.28966
BRAKE SPECIFIC HC	LBM/BHP-HR	0.40503	0.04019	0.02149	0.00733	0.00467	0.00125	0.00128
HC MASS / MODE	LB	0.02931	0.10732	0.05672	0.00931	0.00605	0.00153	0.00145
CO EMISSION RATE	LB/HR	9.30682	15.40998	2.65577	155.85957	76.53378	2.35824	2.44782
BRAKE SPECIFIC CO	LBM/BHP-HR	2.14384	1.05795	0.18450	0.61362	0.29556	0.00968	0.01080
CO MASS / MODE	LB	0.15511	2.82516	0.48689	0.77930	0.38267	0.01179	0.01224
NOX EMISSION RATE	LB/HR	0.00245	0.01973	0.08815	0.97617	3.89795	9.30696	9.08377
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00057	0.00135	0.00612	0.00384	0.01505	0.03819	0.04009
NOX MASS / MODE	LB	0.00004	0.00362	0.01616	0.00488	0.01949	0.04653	0.04542

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 2	MODE 3	MODE 3	MODE 3	MODE 3
CAL. FUEL AIR RATIO	LB/LB	0.09248	0.09029	0.06996	0.09013	0.07776	0.05968	0.05320
DIFF. CALC & MEAS F/A	PERCENT	1.66	7.22	12.41	0.06	1.00	2.83	2.62
DIFF EV & CB RATE	PERCENT	0.05	0.99	1.91	0.05	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.06346	1.09547	1.06445	1.05115	1.02472	0.98482	0.99541

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6-285-B S/N 700106 TEST 9A LEANOUT 50 DEG BTC RUNS 141-147 01/06/76

PBARC	TDRY	INLET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.124	67.00	65.00	2.1250	67.00	285.00	406.00	3.000	5.550	1.255

	UNITS	MODE 3	MODE 4	MODE 4	MODE 4	MODE 5	MODE 5	MODE 5
RUN NUMBER	--	141.	142.	143.	144.	145.	146.	147.
TIME IN MODE	MINUTES	0.30	5.00	5.00	5.00	6.00	6.00	6.00
FUEL FLOW	LB/HR	85.00	118.00	90.00	70.00	74.00	65.00	55.00
INDUCTION AIR FLOW (W)	LB/HR	1780.00	1460.00	1435.00	1510.00	880.00	885.00	890.00
HYDROCARBON CONC.	PPM-C W	555.00	1950.00	1155.00	900.00	2850.00	2325.00	1920.00
OXIDES OF NITROGEN CONC	PPM W	1037.50	430.00	3100.00	1700.00	265.00	1100.00	3100.00
CARBON MONOXIDE CONC.	PERCENT	0.20	8.80	1.00	0.20	10.35	5.75	0.99
CARBON DIOXIDE CONC.	PERCENT	10.05	9.65	13.20	10.25	8.65	11.10	13.30
OXYGEN CONC.	PERCENT	6.25	0.13	0.50	5.87	0.13	0.13	0.62
WET CORRECTION FACTOR	--	0.88602	0.84417	0.84417	0.86486	0.84417	0.84417	0.84417
PROP. TORQUE	FT-LB	530.00	600.00	602.00	473.00	328.00	338.00	341.00
PROP. SPEED	RPM	2000.00	1800.00	1800.00	1800.00	1740.00	1740.00	1740.00
FIELD PRESSURE	IN HG ABS DRY	28.20	25.70	25.70	25.70	16.50	16.50	16.50
INDUCTION AIR TEMP	DEG F	75.00	76.00	76.00	76.00	72.00	70.00	70.00
COOLING AIR TEMP	DEG F	78.00	78.00	78.00	78.00	70.00	70.00	70.00
COOLING AIR DELTA P	IN H2O	4.90	6.40	6.40	6.40	7.00	7.00	7.00
MAX CYL HEAD TEMP	DEG F	366.00	417.00	417.00	300.00	355.00	385.00	387.00
EXHAUST GAS TEMP	DEG F	1250.00	1194.00	1318.00	1173.00	1015.00	1098.00	1160.00
INDUCTION F/A RATIO (D)	LB/LB	0.04836	0.08185	0.06351	0.04695	0.08516	0.07438	0.06258
IND. F/A EQUIV. RATIO	--	0.72	1.22	0.95	0.70	1.27	1.11	0.94
ENGINE OBSERVED POWER	HP	201.83	205.64	206.32	162.11	108.67	111.98	112.92
OBS BMEP	PSI	98.43	111.43	111.80	87.84	60.91	62.77	63.33
OBS BSFC	LBM/BHP-HR	0.421	0.574	0.436	0.432	0.681	0.580	0.487
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.50618	1.43052	0.86207	0.67668	1.26664	1.02488	0.84480
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00251	0.00696	0.00408	0.00417	0.01166	0.00915	0.00748
HC MASS / MODE	LB	0.00253	0.11921	0.07017	0.05639	0.12666	0.10249	0.08448
CO EMISSION RATE	LB/HR	3.26268	110.01700	12.42467	2.62545	78.39070	43.19518	7.42340
BRAKE SPECIFIC CO	LBM/BHP-HR	0.01617	0.53501	0.06022	0.01620	0.72138	0.38574	0.06571
CO MASS / MODE	LB	0.01631	9.16808	1.03539	0.21879	7.83907	4.31951	0.74234
NOX EMISSION RATE	LB/HR	3.13767	1.04601	7.49440	4.23837	0.39053	1.60787	4.52293
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.01555	0.00509	0.03632	0.02615	0.00359	0.01436	0.04004
NOX MASS / MODE	LB	0.01569	0.08717	0.62453	0.35320	0.03905	0.16079	0.45229
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.04845	0.08721	0.06807	0.04976	0.09229	0.08015	0.06809
DIFF. CALC & MEAS F/A	PERCENT	0.20	6.55	7.17	5.98	8.38	7.75	8.81
DIFF EV & CB RATE	PERCENT	0.05	1.03	0.63	0.05	1.13	1.26	1.03
SUM OF MOLE FRACTIONS		0.99177	1.08648	1.00821	1.00846	1.09252	1.06585	1.03204

6-285-B S/N 700106 TEST 9B LEANOUT 50 DEG BTC RUN 148 01/06/76

PBARO	TORY	TMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.124	67.00	65.00	2.1250	67.00	285.00	406.00	3.000	5.550	1.255

	UNITS	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	148.						
TIME IN MODE	MINUTES	6.00						
FUEL FLOW	LB/HR	50.00						
INDUCTION AIR FLOW (W)	LB/HR	890.00						
HYDROCARBON CONC.	PPM-C W	900.00						
OXIDES OF NITROGEN CONC	PPM W	3150.00						
CARBON MONOXIDE CONC.	PERCENT	0.20						
CARBON DIOXIDE CONC.	PERCENT	12.40						
OXYGEN CONC.	PERCENT	2.50						
WET CORRECTION FACTOR	--	0.85056						
PROP. TORQUE	FT-LB	327.00						
PROP. SPEED	RPM	1740.00						
FIELD PRESSURE	IN HG ABS DRY	16.50						
INDUCTION AIR TEMP	DEG F	70.00						
COOLING AIR TEMP	DEG F	69.00						
COOLING AIR DELTA P	IN H2O	3.80						
MAX CYL HEAD TEMP	DEG F	368.00						
EXHAUST GAS TEMP	DEG F	1220.00						
INDUCTION F/A RATIO (D)	LB/LB	0.05689						
IND. F/A EQUIV. RATIO	--	0.85						
ENGINE OBSERVED POWER	HP	108.34						
OBS BMEP	PSI	60.73						
OBS BSFC	LBM/BHP-HR	0.462						
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.40824						
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00377						
HC MASS / MODE	LB	0.04082						
CO EMISSION RATE	LB/HR	1.55773						
BRAKE SPECIFIC CO	LBM/BHP-HR	0.01438						
CO MASS / MODE	LB	0.15577						
NOX EMISSION RATE	LB/HR	4.73793						
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.04373						
NOX MASS / MODE	LB	0.47379						
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.06011						
DIFF. CALC & MEAS F/A	PERCENT	5.65						
DIFF EV & CB RATE	PERCENT	0.05						
SUM OF MOLE FRACTIONS		0.99660						

6-285-B S/N 700106 TEST 10 BASELINE (30 DEG BTC) RUNS 156-162 02/12/76

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.290	61.00	58.50	2.1250	61.00	285.00	406.00	3.000	5.550	0.974

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	156.	157.	158.	159.	160.	161.	162.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	11.30	16.10	154.00	118.00	75.00	16.20	10.80	
INDUCTION AIR FLOW (W)	LB/HR	121.00	203.00	1785.00	1395.00	895.00	200.00	120.00	
HYDROCARBON CONC.	PPM-C W	27750.00	5550.00	1775.00	1845.00	2850.00	4350.00	36750.00	
OXIDES OF NITROGEN CONC	PPM W	8.50	58.00	280.00	370.00	185.00	57.50	7.50	
CARBON MONOXIDE CONC.	PERCENT	10.00	8.75	9.00	8.15	9.75	8.65	9.40	
CARBON DIOXIDE CONC.	PERCENT	7.45	9.50	9.65	10.15	9.15	9.65	7.10	
OXYGEN CONC.	PERCENT	2.25	0.50	0.13	0.13	0.13	0.50	3.25	
WET CORRECTION FACTOR	--	0.85303	0.84876	0.85180	0.85249	0.84876	0.84876	0.84876	
PROP. TORQUE	FT-LB	35.00	77.00	721.00	651.00	348.00	79.00	32.00	
PROP. SPEED	RPM	600.00	900.00	2000.00	1800.00	1740.00	900.00	600.00	
MELD PRESSURE	IN HG ABS DRY	11.50	10.90	28.20	25.70	16.50	10.50	11.70	
INDUCTION AIR TEMP	DEG F	66.00	64.00	66.00	68.00	68.00	67.00	67.00	
COOLING AIR TEMP	DEG F	73.00	73.00	70.00	71.00	71.00	77.00	77.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	3.00	3.00	3.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	309.00	353.00	433.00	400.00	353.00	327.00	351.00	
EXHAUST GAS TEMP	DEG F	500.00	635.00	1330.00	1255.00	1068.00	670.00	470.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09431	0.08009	0.08712	0.08542	0.08462	0.08180	0.09088	0.08324 TA
IND. F/A EQUIV. RATIO	--	1.41	1.20	1.30	1.28	1.27	1.22	1.36	1.25 TA
ENGINE OBSERVED POWER	HP	4.00	13.19	274.56	223.11	115.29	13.54	3.66	
CBS BMEP	PSI	6.50	14.30	133.90	120.90	64.63	14.67	5.94	
CBS BSFC	LBM/BHP-HR	2.826	1.220	0.561	0.529	0.651	1.197	2.954	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.74080	0.54600	1.66834	1.35221	1.28357	0.63269	2.20099	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.43537	0.04138	0.00608	0.00606	0.01113	0.03196	0.60206	
HC MASS / MODE	LB	0.02901	0.10010	0.00834	0.11268	0.12836	0.02163	0.03668	0.43681
HC MASS / RATED HP	LB/HP								0.00153
HC - PERCENT OF EPA STANDARD									80.67
CO EMISSION RATE	LB/HR	10.80285	14.74952	145.46353	102.79636	75.24039	14.74279	9.64631	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.70174	1.11781	0.52980	0.46073	0.65260	1.08902	2.63867	
CO MASS / MODE	LB	0.18005	2.70408	0.72732	8.56636	7.52404	0.73714	0.16077	20.59973
CO MASS / RATED HP	LB/HP								0.07228
CO - PERCENT OF EPA STANDARD									172.09
NOX EMISSION RATE	LB/HR	0.00177	0.01892	0.87267	0.89920	0.27628	0.01897	0.00149	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00044	0.00143	0.00318	0.00403	0.00240	0.00140	0.00041	
NOX MASS / MODE	LB	0.00003	0.00347	0.00436	0.07493	0.02763	0.00095	0.00002	0.11140
NOX MASS / RATED HP	LB/HP								0.00039
NOX- PERCENT OF EPA STANDARD									26.06

** DATA VALIDITY CHECKS FOR ENGI07 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09915	0.08786	0.08745	0.08525	0.09023	0.08678	0.09971	0.08863 TA
DIFF. CALC & MEAS F/A	PERCENT	5.13	9.70	0.38	-0.20	6.63	6.10	9.71	6.47 TA
DIFF EV & CB RATE	PERCENT	0.05	1.64	0.05	0.05	1.04	1.00	0.39	
SUM OF MOLE FRACTIONS		1.07670	1.11526	1.05575	1.05157	1.09310	1.05538	1.09976	

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6-285-B S/N 700106 TEST 11 CONST POWER,VAR RPM & MAP RUNS 163-167 02/14/76

PBARO	TDRY	TWET	FUEL HYDROGEN–CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C – H FORMULA		PERCENT
30.340	57.00	57.00	2.1250	57.00	285.00	406.00	3.000	5.550	0.974

	UNITS	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 0	MODE 0
RUN NUMBER	--	163.	164.	165.	166.	167.		
TIME IN MODE	MINUTES	5.00	5.00	5.00	5.00	5.00		
FUEL FLOW	LB/HR	121.00	118.00	115.00	115.00	110.00		
INDUCTION AIR FLOW (W)	LB/HR	1425.00	1375.00	1350.00	1335.00	1295.00		
HYDROCARBON CONC.	PPM-C W	1800.00	1785.00	1740.00	1725.00	1920.00		
OXIDES OF NITROGEN CONC	PPM W	360.00	360.00	375.00	375.00	325.00		
CARBON MONOXIDE CONC.	PERCENT	8.35	8.35	8.15	8.15	8.35		
CARBON DIOXIDE CONC.	PERCENT	10.05	10.05	10.05	10.05	9.95		
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0		
WET CORRECTION FACTOR	--	0.85022	0.85380	0.85358	0.85732	0.85041		
PROP. TORQUE	FT-LB	581.00	600.00	632.00	674.00	707.00		
PROP. SPEED	RPM	2000.00	1900.00	1800.00	1700.00	1600.00		
MELD PRESSURE	IN HG ABS DRY	23.80	24.20	25.15	26.35	27.70		
INDUCTION AIR TEMP	DEG F	69.00	70.00	71.00	72.00	72.00		
COOLING AIR TEMP	DEG F	69.00	70.00	70.00	70.00	70.00		
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00		
MAX CYL HEAD TEMP	DEG F	417.00	412.00	403.00	389.00	383.00		
EXHAUST GAS TEMP	DEG F	0.0	0.0	0.0	0.0	0.0		
INDUCTION F/A RATIO (D)	LB/LB	0.08575	0.08666	0.08602	0.08699	0.08578		
IND. F/A EQUIV. RATIO	--	1.28	1.30	1.29	1.30	1.28		
ENGINE OBSERVED POWER	HP	221.25	217.06	216.60	218.16	215.34		
CBS BMEP	PSI	107.90	111.43	117.37	125.17	131.30		
CBS BSFC	LBM/BHP-HR	0.547	0.544	0.531	0.527	0.511		
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.34942	1.29971	1.24883	1.23283	1.31432		
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00610	0.00599	0.00577	0.00565	0.00610		
HC MASS / MODE	LB	0.11245	0.10831	0.10407	0.10274	0.10953		
CO EMISSION RATE	LB/HR	107.44368	104.79462	100.79575	100.81018	98.12915		
BRAKE SPECIFIC CO	LBM/BHP-HR	0.48562	0.48279	0.46535	0.46208	0.45560		
CO MASS / MODE	LB	8.95364	8.73288	8.39964	8.40085	8.17743		
NOX EMISSION RATE	LB/HR	0.89492	0.86920	0.89246	0.88870	0.73772		
BRAKE SPECIFIC NOX	LBM/BHP-HP	0.00404	0.00400	0.00412	0.00407	0.00343		
NOX MASS / MODE	LB	0.07458	0.07243	0.07437	0.07406	0.06148		
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.08621	0.08619	0.08582	0.08581	0.08643		
DIFF. CALC & MEAS F/A	PERCENT	0.53	-0.54	-0.23	-1.35	0.76		
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05		
SUM OF MOLE FRACTIONS		1.05040	1.04701	1.04054	1.03697	1.04530		

F-28

6-285-8 S/N 700106 TEST 11A CONST POWER,VAR RPM & MAP RUNS 168-170 02/14/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.340	57.00	57.00	2.1250	57.00	285.00	406.00	3.000	5.550	0.974

	UNITS	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	168.	169.	170.				
TIME IN MODE	MINUTES	6.00	6.00	6.00				
FUEL FLOW	LB/HR	69.50	68.50	66.00				
INDUCTION AIR FLOW (W)	LB/HR	827.00	825.00	810.00				
HYDROCARBON CONC.	PPM-C W	2700.00	2670.00	2670.00				
OXIDES OF NITROGEN CONC	PPM W	160.00	180.00	190.00				
CARBON MONOXIDE CONC.	PERCENT	10.00	8.75	9.50				
CARBON DIOXIDE CONC.	PERCENT	8.85	9.15	9.25				
OXYGEN CONC.	PERCENT	0.0	0.0	0.0				
WET CORRECTION FACTOR	--	0.84875	0.84875	0.84875				
PROP. TORQUE	FT-LB	325.00	357.00	376.00				
PROP. SPEED	RPM	1700.00	1600.00	1500.00				
MFLD PRESSURE	IN HG ABS DRY	15.90	16.80	17.80				
INDUCTION AIR TEMP	DEG F	71.00	71.00	72.00				
COOLING AIR TEMP	DEG F	70.00	70.00	70.00				
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00				
MAX CYL HEAD TEMP	DEG F	325.00	325.00	324.00				
EXHAUST GAS TEMP	DEG F	0.0	0.0	0.0				
INDUCTION F/A RATIO (D)	LB/LB	0.08487	0.08385	0.08228				
IND. F/A EQUIV. RATIO	--	1.27	1.25	1.23				
ENGINE OBSERVED POWER	HP	105.20	108.76	107.39				
OBS BMEP	PSI	60.36	66.30	69.83				
OBS BSFC	LBM/BHP-HR	0.661	0.630	0.615				
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.13083	1.15987	1.06771				
BRAKE SPECIFIC HC	LBM/BHP-HR	0.01075	0.01066	0.00994				
HC MASS / MODE	LB	0.11308	0.11599	0.10677				
CO EMISSION RATE	LB/HR	71.76300	65.12904	65.09319				
BRAKE SPECIFIC CO	LBM/BHP-HR	0.68217	0.59884	0.60615				
CO MASS / MODE	LB	7.17630	6.51290	6.50932				
NOX EMISSION RATE	LB/HR	0.22221	0.25928	0.25194				
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00211	0.00238	0.00235				
NOX MASS / MODE	LB	0.02222	0.02593	0.02519				
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09170	0.08891	0.09003				
DIFF. CALC & MEAS F/A	PERCENT	8.06	6.04	9.41				
DIFF EV & CB RATE	PERCENT	1.18	0.65	1.58				
SUM OF MOLE FRACTIONS		1.08624	1.04077	1.10398				

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6-285-B S/N 700106 TEST 12 INDUCTION AIR PRESSURE VAR. RUNS 171-175 02/16/76

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.250	65.00	63.00	2.1250	65.00	265.00	406.00	3.000	5.550	1.166

	UNITS	MODE 1	MODE 1	MODE 1	MODE 1	MODE 1	MODE 0	MODE 0
RUN NUMBER	--	171.	172.	173.	174.	175.		
TIME IN MODE	MINUTES	1.00	1.00	1.00	1.00	1.00		
FUEL FLOW	LB/HR	10.95	10.70	10.70	10.80	10.90		
INDUCTION AIR FLOW (W)	LB/HR	115.00	115.00	115.00	115.00	121.00		
HYDROCARBON CONC.	PPM-C W	24000.00	28500.00	25500.00	25500.00	25500.00		
OXIDES OF NITROGEN CONC	PPM W	12.50	10.50	11.00	10.50	11.00		
CARBON MONOXIDE CONC.	PERCENT	9.90	9.50	9.85	9.90	9.90		
CARBON DIOXIDE CONC.	PERCENT	8.00	7.70	7.90	7.70	7.80		
OXYGEN CONC.	PERCENT	1.87	2.50	2.13	2.13	2.13		
WET CORRECTION FACTOR	--	0.85977	0.85653	0.85300	0.85629	0.84563		
PROP. TORQUE	FT-LB	35.00	35.00	35.00	35.00	36.00		
PROP. SPEED	RPM	600.00	600.00	600.00	600.00	600.00		
MFLD PRESSURE	IN HG ABS DRY	11.40	11.60	11.40	11.60	11.60		
INDUCTION AIR TEMP	DEG F	70.00	70.00	70.00	70.00	70.00		
COOLING AIR TEMP	DEG F	76.00	76.00	76.00	76.00	76.00		
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0		
MAX CYL HEAD TEMP	DEG F	302.00	351.00	316.00	340.00	354.00		
EXHAUST GAS TEMP	DEG F	490.00	462.00	480.00	485.00	470.00		
INDUCTION F/A RATIO (D)	LB/LB	0.09634	0.09414	0.09414	0.09502	0.09114		
IND. F/A EQUIV. RATIO	--	1.44	1.41	1.41	1.42	1.36		
ENGINE OBSERVED POWER	HP	4.00	4.00	4.00	4.00	4.11		
CBS BMEP	PSI	6.50	6.50	6.50	6.50	6.69		
CBS BSFC	LBM/BHP-HR	2.739	2.676	2.676	2.701	2.650		
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.44831	1.70044	1.51212	1.53232	1.55561		
BRAKE SPECIFIC HC	LBM/BHP-HR	0.36222	0.42527	0.37817	0.38323	0.37824		
HC MASS / MODE	LB	0.02414	0.02834	0.02520	0.02554	0.02593		
CO EMISSION RATE	LB/HR	10.36940	9.80098	10.05815	10.28376	10.31007		
BRAKE SPECIFIC CO	LBM/BHP-HR	2.59334	2.45118	2.51550	2.57192	2.50687		
CO MASS / MODE	LB	0.17282	0.16335	0.16764	0.17140	0.17183		
NOX EMISSION RATE	LB/HR	0.00250	0.00208	0.00216	0.00209	0.00223		
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00063	0.00052	0.00054	0.00052	0.00054		
NOX MASS / MODE	LB	0.00004	0.00003	0.00004	0.00003	0.00004		
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09707	0.09692	0.09704	0.09758	0.09750		
DIFF. CALC & MEAS F/A	PERCENT	0.76	2.95	3.08	2.69	6.97		
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.33		
SUM OF MOLE FRACTIONS		1.07479	1.07703	1.08531	1.07414	1.09849		

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6-285-B S/N 700106 TEST 12A INDUCTION AIR PRESSURE VAR. RUNS 176-180 02/16/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.250	65.00	63.00	2.1250	65.00	285.00	406.00	3.000	5.550	1.166

	UNITS	MODE 2	MODE 2	MODE 2	MODE 2	MODE 2	MODE 0	MODE 0
RUN NUMBER	--	176.	177.	178.	179.	180.		
TIME IN MODE	MINUTES	11.00	11.00	11.00	11.00	11.00		
FUEL FLOW	LB/HR	17.00	16.40	16.60	15.60	16.10		
INDUCTION AIR FLOW (W)	LB/HR	198.00	195.00	202.00	198.00	205.00		
HYDROCARBON CONC.	PPM-C W	4200.00	4350.00	3825.00	3900.00	3600.00		
OXIDES OF NITROGEN CONC	PPM W	52.50	56.00	60.00	61.00	68.50		
CARBON MONOXIDE CONC.	PERCENT	9.20	9.20	8.50	8.50	8.20		
CARBON DIOXIDE CONC.	PERCENT	9.55	9.55	9.85	9.85	9.95		
OXYGEN CONC.	PERCENT	0.50	0.50	0.42	0.42	0.42		
WET CORRECTION FACTOR	--	0.84677	0.84563	0.84563	0.84563	0.84563		
PROP. TORQUE	FT-LB	78.00	79.00	80.00	80.00	80.00		
PROP. SPEED	RPM	900.00	900.00	900.00	900.00	900.00		
MELD PRESSURE	IN HG ABS DRY	10.70	10.80	10.70	10.90	10.90		
INDUCTION AIR TEMP	DEG F	70.00	70.00	70.00	70.00	71.00		
COOLING AIR TEMP	DEG F	76.00	76.00	76.00	76.00	76.00		
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0		
MAX CYL HEAD TEMP	DEG F	334.00	378.00	343.00	380.00	398.00		
EXHAUST GAS TEMP	DEG F	658.00	652.00	655.00	652.00	655.00		
INDUCTION F/A RATIO (D)	LB/LB	0.08687	0.08509	0.08315	0.07972	0.07946		
IND. F/A EQUIV. RATIO	--	1.30	1.27	1.24	1.19	1.19		
ENGINE OBSERVED POWER	HP	13.37	13.54	13.71	13.71	13.71		
CBS BMEP	PSI	14.49	14.67	14.86	14.86	14.86		
CBS BSFC	LBM/BHP-HR	1.272	1.211	1.211	1.138	1.174		
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.42954	0.42934	0.39152	0.37497	0.36175		
BRAKE SPECIFIC HC	LBM/BHP-HR	0.03214	0.03171	0.02856	0.02735	0.02639		
HC MASS / MODE	LB	0.07875	0.07871	0.07178	0.06875	0.06632		
CO EMISSION RATE	LB/HR	16.08389	15.50140	14.85288	13.95155	14.06660		
BRAKE SPECIFIC CO	LBM/BHP-HR	1.20331	1.14505	1.08343	1.01769	1.02608		
CO MASS / MODE	LB	2.94871	2.84192	2.72303	2.55778	2.57888		
NOX EMISSION RATE	LB/HR	0.01780	0.01833	0.02036	0.01945	0.02282		
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00133	0.00135	0.00149	0.00142	0.00166		
NOX MASS / MODE	LB	0.00326	0.00336	0.00373	0.00357	0.00418		
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.08781	0.08789	0.08623	0.08627	0.08544		
DIFF. CALC & MEAS F/A	PERCENT	1.08	3.29	3.71	8.22	7.53		
DIFF EV & CB RATE	PERCENT	0.05	0.45	0.54	1.47	1.31		
SUM OF MOLE FRACTIONS		1.07533	1.09014	1.08143	1.11437	1.10336		

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6-285-B S/N 700106 TEST 12B INDUCTION AIR PRESSURE VAR. RUNS 181-185 02/16/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.250	65.00	63.00	2.1250	65.00	285.00	406.00	3.000 5.550	1.166

	UNITS	MODE 3	MODE 3	MODE 3	MODE 3	MODE 3	MODE 0	MODE 0
RUN NUMBER	--	181.	182.	183.	184.	185.		
TIME IN MODE	MINUTES	0.30	0.30	0.30	0.30	0.30		
FUEL FLOW	LB/HR	147.00	150.00	152.00	153.00	154.00		
INDUCTION AIR FLOW (W)	LB/HR	1760.00	1815.00	1845.00	1915.00	1941.00		
HYDROCARBON CONC.	PPM-C W	1860.00	1770.00	1695.00	1590.00	1560.00		
OXIDES OF NITROGEN CONC	PPM W	210.00	230.00	260.00	320.00	350.00		
CARBON MONOXIDE CONC.	PERCENT	9.85	9.35	9.00	8.35	8.00		
CARBON DIOXIDE CONC.	PERCENT	9.35	9.55	9.75	10.15	10.35		
OXYGEN CONC.	PERCENT	0.06	0.0	0.0	0.0	0.06		
WET CORRECTION FACTOR	--	0.84563	0.84563	0.84563	0.84563	0.84563		
PROP. TORQUE	FT-LB	675.00	700.00	720.00	744.00	754.00		
PROP. SPEED	RPM	2000.00	2000.00	2000.00	2000.00	2000.00		
MFLD PRESSURE	IN HG ABS DRY	26.90	27.60	28.20	29.10	29.45		
INDUCTION AIR TEMP	DEG F	70.00	73.00	75.00	76.00	78.00		
COOLING AIR TEMP	DEG F	75.00	75.00	76.00	76.00	76.00		
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00		
MAX CYL HEAD TEMP	DEG F	405.00	406.00	425.00	435.00	440.00		
EXHAUST GAS TEMP	DEG F	0.0	1315.00	1334.00	1355.00	1365.00		
INDUCTION F/A RATIO (D)	LB/LB	0.08451	0.08362	0.08336	0.08084	0.08028		
IND. F/A EQUIV. RATIO	--	1.26	1.25	1.25	1.21	1.20		
ENGINE OBSERVED POWER	HP	257.04	266.56	274.18	283.32	287.13		
OBS BMEP	PSI	125.36	130.00	133.71	138.17	140.03		
OBS BSFC	LBM/BHP-HR	0.572	0.563	0.554	0.540	0.536		

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 3	MODE 3	MODE 3	MODE 3	MODE 3
HC EMISSION RATE	LB/HR	1.63234	1.61082	1.57624	1.50922	1.50277
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00635	0.00604	0.00575	0.00533	0.00523
HC MASS / MODE	LB	0.00816	0.00805	0.00788	0.00755	0.00751
CO EMISSION RATE	LB/HR	147.57085	145.26234	142.87688	135.30368	131.56056
BRAKE SPECIFIC CO	LBM/BHP-HR	0.57411	0.54494	0.52110	0.47756	0.45819
CO MASS / MODE	LB	0.73785	0.72631	0.71438	0.67652	0.65780
NOX EMISSION RATE	LB/HR	0.61112	0.69408	0.80174	1.00719	1.11800
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00238	0.00260	0.00292	0.00355	0.00389
NOX MASS / MODE	LB	0.00306	0.00347	0.00401	0.00504	0.00559

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 3	MODE 3	MODE 3	MODE 3	MODE 3
CAL. FUEL AIR RATIO	LB/LB	0.08975	0.08873	0.08775	0.08595	0.08481
DIFF. CALC & MEAS F/A	PERCENT	6.20	6.11	5.27	6.32	5.65
DIFF EV & CB RATE	PERCENT	1.06	1.04	0.90	1.19	1.09
SUM OF MOLE FRACTIONS		1.10458	1.09455	1.08795	1.09640	1.09330

[illegible] S/N 700106 TEST 12C INDUCTION AIR PRESSURE VAR. RUNS 186-190 02/16/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.250	65.00	63.00	2.1250	65.00	285.00	406.00	3.000	5.550	1.166

	UNITS	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 0	MODE 0
RUN NUMBER	--	186.	187.	188.	189.	190.		
TIME IN MODE	MINUTES	5.00	5.00	5.00	5.00	5.00		
FUEL FLOW	LB/HR	115.00	116.00	116.00	117.00	118.00		
INDUCTION AIR FLOW (W)	LB/HR	1370.00	1375.00	1385.00	1385.00	1380.00		
HYDROCARBON CONC.	PPM-C W	1680.00	1695.00	1725.00	1770.00	1800.00		
OXIDES OF NITROGEN CONC	PPM W	410.00	410.00	385.00	365.00	340.00		
CARBON MONOXIDE CONC.	PERCENT	7.75	7.85	8.20	8.35	8.50		
CARBON DIOXIDE CONC.	PERCENT	10.45	10.35	10.25	10.15	10.05		
OXYGEN CONC.	PERCENT	0.06	0.06	0.06	0.06	0.06		
WET CORRECTION FACTOR	--	0.85085	0.85177	0.84578	0.84731	0.85005		
FRCP. TORQUE	FT-LB	648.00	648.00	644.00	644.00	651.00		
FRCP. SPEED	RPM	1800.00	1800.00	1800.00	1800.00	1800.00		
MFLD PRESSURE	IN HG ABS DRY	25.70	25.70	25.70	25.70	25.70		
INDUCTION AIR TEMP	DEG F	73.00	75.00	76.00	77.00	78.00		
COOLING AIR TEMP	DEG F	76.00	76.00	77.00	77.00	78.00		
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00	3.00		
MAX CYL HEAD TEMP	DEG F	404.00	401.00	401.00	397.00	395.00		
EXHAUST GAS TEMP	DEG F	1270.00	1270.00	1260.00	1256.00	1252.00		
INDUCTION F/A RATIO (O)	LB/LB	0.08493	0.08536	0.08474	0.08547	0.08652		
IND. F/A EQUIV. RATIO	--	1.27	1.28	1.27	1.28	1.29		
ENGINE OBSERVED POWER	HP	222.09	222.09	220.72	220.72	223.11		
CBS BMEP	PSI	120.34	120.34	119.60	119.60	120.90		
CBS BSFC	LBM/BHP-HR	0.518	0.522	0.526	0.530	0.529		

CARBON BALANCE MASS EMISSIONS

HC EMISSION RATE	LB/HR	1.21006	1.23003	1.24344	1.28079	1.30571
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00545	0.00554	0.00563	0.00580	0.00585
HC MASS / MODE	LB	0.10084	0.10250	0.10362	0.10673	0.10881
CO EMISSION RATE	LB/HR	95.88202	97.95547	100.92441	103.35210	105.80904
BRAKE SPECIFIC CO	LBM/BHP-HR	0.43173	0.44107	0.45726	0.46826	0.47424
CO MASS / MODE	LB	7.99016	8.16296	8.41036	8.61267	8.81742
NOX EMISSION RATE	LB/HR	0.97924	0.98659	0.92025	0.87580	0.81782
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00441	0.00444	0.00417	0.00397	0.00367
NOX MASS / MODE	LB	0.08160	0.08222	0.07669	0.07298	0.06815

** DATA VALIDITY CHECKS FOR ENG107 **

CAL. FUEL AIR RATIO	LB/LB	0.08431	0.08462	0.08539	0.08581	0.08623
DIFF. CALC & MEAS F/A	PERCENT	-0.74	-0.86	0.76	0.40	-0.33
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.04951	1.04707	1.05937	1.05801	1.05550

6-285-B S/N 700106 TEST 12D INDUCTION AIR PRESSURE VAR. RUNS 191-194 02/16/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.250	65.00	63.00	2.1250	65.00	285.00	406.00	3.000	5.550	1.166

	UNITS	MODE 5	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	191.	192.	193.	194.			
TIME IN MODE	MINUTES	6.00	6.00	6.00	6.00			
FUEL FLOW	LB/HR	76.00	76.00	74.00	74.00			
INDUCTION AIR FLOW (W)	LB/HR	895.00	915.00	895.00	900.00			
HYDROCARBON CONC.	PPM-C W	2775.00	2770.00	2700.00	2700.00			
OXIDES OF NITROGEN CONC	PPM W	162.50	181.25	182.50	197.50			
CARBON MONOXIDE CONC.	PERCENT	10.25	10.05	9.90	9.85			
CARBON DIOXIDE CONC.	PERCENT	8.95	9.15	9.15	9.35			
OXYGEN CONC.	PERCENT	0.13	0.13	0.13	0.13			
WET CORRECTION FACTOR	--	0.84563	0.84563	0.84563	0.84563			
PROP. TORQUE	FT-LB	347.00	348.00	348.00	344.00			
PROP. SPEED	RPM	1740.00	1740.00	1740.00	1740.00			
MFLD PRESSURE	IN HG ABS DRY	16.50	16.50	16.50	16.50			
INDUCTION AIR TEMP	DEG F	74.00	76.00	77.00	78.00			
COOLING AIR TEMP	DEG F	77.00	78.00	78.00	78.00			
COOLING AIR DELTA P	IN H2O	3.00	3.00	3.00	3.00			
MAX CYL HEAD TEMP	DEG F	335.00	340.00	339.00	339.00			
EXHAUST GAS TEMP	DEG F	1070.00	1075.00	1073.00	1080.00			
INDUCTION F/A RATIO (D)	LB/LB	0.08592	0.08404	0.08366	0.08319			
IND. F/A EQUIV. RATIO	--	1.29	1.26	1.25	1.24			
ENGINE OBSERVED POWER	HP	114.96	115.29	115.29	113.97			
CBS BMEP	PSI	64.44	64.63	64.63	63.89			
CBS BSFC	LBM/BHP-HR	0.661	0.659	0.642	0.649			

CARBON BALANCE MASS EMISSIONS

	UNITS				
HC EMISSION RATE	LB/HR	1.25211	1.24990	1.19594	1.18675
BRAKE SPECIFIC HC	LBM/BHP-HR	0.01089	0.01084	0.01037	0.01041
HC MASS / MODE	LB	0.12521	0.12499	0.11959	0.11868
CO EMISSION RATE	LB/HR	78.95352	77.41530	74.85977	73.90932
BRAKE SPECIFIC CO	LBM/BHP-HR	0.68678	0.67146	0.64930	0.64851
CO MASS / MODE	LB	7.89535	7.74153	7.48597	7.39093
NOX EMISSION RATE	LB/HR	0.24313	0.27119	0.26805	0.28785
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00211	0.00235	0.00232	0.00253
NOX MASS / MODE	LB	0.02431	0.02712	0.02681	0.02879

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS				
CAL. FUEL AIR RATIO	LB/LB	0.09144	0.09070	0.09041	0.08994
DIFF. CALC & MEAS F/A	PERCENT	6.43	7.92	8.07	8.11
DIFF EV & CB RATE	PERCENT	0.94	1.33	1.32	1.44
SUM OF MOLE FRACTIONS		1.09714	1.11411	1.10869	1.12166

APPENDIX G. GTSIO-520-K TEST DATA

GTSIO-520-K S/N 220015 TEST 1 BASELINE (20 DEG BTC) RUNS 1-7 03/17/76

PBARO	IDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.219	62.50	48.00	2.1250	62.50	435.00	520.00	3.000	5.550	0.377

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	1.	2.	3.	4.	5.	6.	7.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.80	19.00	306.00	225.00	93.00	15.50	12.80	
INDUCTION AIR FLOW (W)	LB/HR	150.00	225.00	3046.00	2317.00	1099.00	226.00	151.00	
HYDROCARBON CONC.	PPM-C W	36000.00	5850.00	1875.00	1845.00	1455.00	5400.00	20250.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	55.00	32.50	49.00	340.00	52.50	14.00	
CARBON MONOXIDE CONC.	PERCENT	9.05	9.25	13.75	13.15	7.65	8.90	9.05	
CARBON DIOXIDE CONC.	PERCENT	7.65	9.35	6.30	6.70	10.25	9.35	8.45	
OXYGEN CONC.	PERCENT	1.25	0.0	0.0	0.0	0.0	0.13	1.25	
WET CORRECTION FACTOR	--	0.85843	0.85843	0.86667	0.86064	0.86217	0.85843	0.85843	
PROP. TORQUE	FT-LB	50.00	115.00	947.00	844.00	514.00	110.00	50.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.50	13.80	44.50	36.50	24.00	13.40	14.70	
INDUCTION AIR TEMP	DEG F	60.00	59.00	68.00	67.00	66.00	63.00	63.00	
COOLING AIR TEMP	DEG F	73.00	73.00	73.00	73.00	73.00	73.00	73.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	285.00	357.00	429.00	404.00	345.00	357.00	357.00	
EXHAUST GAS TEMP	DEG F	638.00	817.00	1468.00	1402.00	1395.00	869.00	670.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08566	0.08476	0.10084	0.09748	0.08494	0.06884	0.08509	0.08560 TA
IND. F/A EQUIV. RATIO	--	1.28	1.27	1.51	1.46	1.27	1.03	1.27	1.28 TA
ENGINE OBSERVED POWER	HP	5.71	19.71	408.95	327.99	169.70	18.85	5.71	
OBS BMEP	PSI	9.67	22.23	183.09	163.17	99.37	21.27	9.67	
OBS BSFC	LBM/BHP-HR	2.241	0.964	0.748	0.686	0.548	0.822	2.241	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	2.51884	0.65837	1.20259	2.35689	0.85160	0.50635	1.49067	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.44096	0.03341	0.00783	0.00719	0.00502	0.02686	0.26097	
HC MASS / MODE	LB	0.04198	0.12070	0.01601	0.19641	0.08516	0.02532	0.02484	0.51042
HC MASS / RATED HP	LB/HP								0.00117
HC - PERCENT OF EPA STANDARD									61.76
CO EMISSION RATE	LB/HR	10.97333	18.04057	410.90723	291.86206	77.93114	14.46228	11.54509	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.92106	0.91545	1.00479	0.88985	0.45922	0.76723	2.02116	
CO MASS / MODE	LB	0.18289	3.30744	2.05453	24.32184	7.79311	0.72311	0.19242	38.57533
CO MASS / RATED HP	LB/HP								0.08868
CO - PERCENT OF EPA STANDARD									211.14
NOX EMISSION RATE	LB/HR	0.00209	0.02053	0.18407	0.20756	0.65987	0.01632	0.00342	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00037	0.00104	0.00045	0.00063	0.00389	0.00087	0.00060	
NOX MASS / MODE	LB	0.00003	0.00376	0.00092	0.01730	0.06599	0.00082	0.00006	0.08887
NOX MASS / RATED HP	LB/HP								0.00020
NOX- PERCENT OF EPA STANDARD									13.62
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.10676	0.09115	0.10524	0.10265	0.08450	0.08979	0.09535	0.09252 TA
DIFF. CALC & MEAS F/A	PERCENT	24.64	7.53	4.36	5.31	-0.52	30.42	12.06	8.08 TA
DIFF EV & CB RATE	PERCENT	3.26	1.34	0.05	0.05	0.05	5.15	1.64	
SUM OF MOLE FRACTIONS		1.13797	1.09177	1.03692	1.04244	1.03264	1.24259	1.10954	

GTSIO-520-K S/N 220015 TEST 2 BASELINE (20 DEG BTC) RUNS 8-14 03/19/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.159	71.00	67.00	2.1250	71.00	435.00	520.00	3.000	5.550	1.309

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	8.	9.	10.	11.	12.	13.	14.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.80	15.30	304.00	222.00	89.00	15.30	12.80	
INDUCTION AIR FLOW (W)	LB/HR	167.00	262.00	3045.00	2376.00	1198.00	234.00	145.00	
HYDROCARBON CONC.	PPM-C W	19500.00	5700.00	1950.00	1860.00	1440.00	6375.00	20000.00	
OXIDES OF NITROGEN CONC	PPM W	15.00	60.00	32.50	57.00	445.00	50.00	12.50	
CARBON MONOXIDE CONC.	PERCENT	8.40	8.55	13.50	12.70	6.50	8.20	7.95	
CARBON DIOXIDE CONC.	PERCENT	9.05	9.65	6.35	7.00	10.75	9.75	8.35	
OXYGEN CONC.	PERCENT	1.25	0.25	0.0	0.0	0.0	0.25	1.25	
WET CORRECTION FACTOR	--	0.84334	0.84334	0.85847	0.84351	0.84334	0.84334	0.84958	
PROP. TORQUE	FT-LB	55.00	120.00	938.00	840.00	515.00	110.00	49.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	13.90	13.90	44.50	36.50	24.00	13.10	14.90	
INDUCTION AIR TEMP	DEG F	67.00	67.00	72.00	72.00	71.00	70.00	69.00	
COOLING AIR TEMP	DEG F	0.0	0.0	77.00	78.00	78.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	324.00	363.00	430.00	410.00	352.00	303.00	330.00	
EXHAUST GAS TEMP	DEG F	[EGT NOT MEASURED]							
INDUCTION F/A RATIO (D)	LB/LB	0.07766	0.05917	0.10116	0.09467	0.07527	0.06625	0.08944	0.07224 TA
IND. F/A EQUIV. RATIO	--	1.16	0.89	1.51	1.42	1.13	0.99	1.34	1.08 TA
ENGINE OBSERVED POWER	HP	6.28	20.56	405.06	326.44	170.03	18.85	5.60	
OBS BMEP	PSI	10.63	23.20	181.35	162.40	99.57	21.27	9.47	
OBS BSFC	LBM/BHP-HR	2.037	0.744	0.751	0.680	0.523	0.812	2.287	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.46829	0.53711	3.37201	2.40926	0.85524	0.60617	1.58369	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.23368	0.02612	0.00832	0.00738	0.00503	0.03216	0.28291	
HC MASS / MODE	LB	0.02447	0.09847	0.01686	0.20077	0.08552	0.03031	0.02639	0.48280
HC MASS / RATED HP	LB/HP								0.00111
HC - PERCENT OF EPA STANDARD									58.42
CO EMISSION RATE	LB/HR	10.76834	13.71657	404.57617	280.12476	65.72522	13.27460	10.79687	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.71380	0.66703	0.99880	0.85813	0.38655	0.70422	1.92875	
CO MASS / MODE	LB	0.17947	2.51470	2.02288	23.34372	6.57252	0.66373	0.17995	35.47696
CO MASS / RATED HP	LB/HP								0.08156
CO - PERCENT OF EPA STANDARD									194.18
NOX EMISSION RATE	LB/HR	0.00375	0.01875	0.18636	0.24482	0.87638	0.01576	0.00328	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00060	0.00091	0.00046	0.00075	0.00515	0.00084	0.00059	
NOX MASS / MODE	LB	0.00006	0.00344	0.00093	0.02040	0.08764	0.00079	0.00005	0.11331
NOX MASS / RATED HP	LB/HP								0.00026
NOX- PERCENT OF EPA STANDARD									17.37
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09279	0.08837	0.10465	0.10085	0.08184	0.08798	0.09379	0.08971 TA
DIFF. CALC & MEAS F/A	PERCENT	19.48	49.34	3.46	6.53	8.72	32.80	4.86	24.20 TA
DIFF EV & CB RATE	PERCENT	3.05	7.78	0.05	0.05	1.49	5.51	0.05	
SUM OF MOLE FRACTIONS		1.17406	1.38800	1.02790	1.04730	1.07473	1.26140	1.00812	

G-2

GTSIO-520-K S/N 220015 TEST 3 BASELINE (20 DEG BTC) RUNS 15-21 03/19/76

PBARO	TCRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.095	70.50	62.00	2.1250	70.50	435.00	520.00	3.000 5.550	0.979

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	15.	16.	17.	18.	19.	20.	21.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.00	19.00	302.00	220.00	92.00	18.40	12.20	
INDUCTION AIR FLOW (W)	LB/HR	151.00	242.00	3036.00	2327.00	1216.00	258.00	149.00	
HYDROCARBON CONC.	PPM-C W	24750.00	6225.00	1980.00	1860.00	1425.00	6450.00	25500.00	
OXIDES OF NITROGEN CONC	PPM W	12.00	41.50	30.00	52.50	375.00	40.00	12.00	
CARBON MONOXIDE CONC.	PERCENT	8.15	9.85	13.60	12.65	6.85	9.25	8.90	
CARBON DIOXIDE CONC.	PERCENT	8.65	8.95	6.45	7.10	10.65	9.20	8.35	
OXYGEN CONC.	PERCENT	1.88	0.38	0.13	0.0	0.0	0.25	1.13	
WET CORRECTION FACTOR	--	0.84868	0.84868	0.86104	0.85048	0.84868	0.84868	0.84868	
PROP. TORQUE	FT-LB	50.00	118.00	937.00	838.00	512.00	112.00	55.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.50	13.60	44.50	36.50	24.00	13.10	14.50	
INDUCTION AIR TEMP	DEG F	68.00	68.00	72.00	72.00	71.00	71.00	70.00	
COOLING AIR TEMP	DEG F	0.0	0.0	78.00	78.00	78.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	278.00	341.00	433.00	406.00	347.00	335.00	360.00	
EXHAUST GAS TEMP	DEG F				[EGT NOT MEASURED]				
INDUCTION F/A RATIO (D)	LB/LB	0.08026	0.07929	0.10046	0.09548	0.07641	0.07202	0.08269	0.08121 TA
IND. F/A EQUIV. RATIO	--	1.20	1.19	1.50	1.43	1.14	1.08	1.24	1.22 TA
ENGINE OBSERVED POWER	HP	5.71	20.22	404.63	325.66	169.06	19.19	6.28	
OBS BMEP	PSI	9.67	22.81	181.15	162.01	98.99	21.65	10.63	
OBS BSFC	LBM/BHP-HR	2.101	0.940	0.746	0.676	0.544	0.959	1.942	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.74019	0.69949	3.35731	2.36228	0.85720	0.71370	1.77435	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.30465	0.03459	0.00830	0.00725	0.00507	0.03719	0.28239	
HC MASS / MODE	LB	0.02900	0.12824	0.01679	0.19686	0.08572	0.03568	0.02957	0.52186
HC MASS / RATED HP	LB/HP								0.00120
HC - PERCENT OF EPA STANDARD									63.14
CO EMISSION RATE	LB/HR	9.81768	18.96292	400.84253	275.84082	70.59738	17.53586	10.61011	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.71875	0.93779	0.99064	0.84703	0.41763	0.91367	1.68861	
CO MASS / MODE	LB	0.16363	3.47655	2.00421	22.98672	7.05974	0.87679	0.17684	36.74443
CO MASS / RATED HP	LB/HP								0.08447
CO - PERCENT OF EPA STANDARD									201.12
NOX EMISSION RATE	LB/HR	0.00280	0.01546	0.16868	0.22110	0.74801	0.01468	0.00277	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00049	0.00076	0.00042	0.00068	0.00442	0.00076	0.00044	
NOX MASS / MODE	LB	0.00005	0.00283	0.00084	0.01842	0.07480	0.00073	0.00005	0.09773
NOX MASS / RATED HP	LB/HP								0.00022
NOX- PERCENT OF EPA STANDARD									14.98
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09341	0.09162	0.10380	0.10042	0.08257	0.09076	0.09908	0.09162 TA
DIFF. CALC & MEAS F/A	PERCENT	16.39	15.56	3.33	5.18	8.06	26.02	15.82	12.82 TA
DIFF EV & CB RATE	PERCENT	2.28	2.65	0.05	0.05	1.47	4.42	2.81	
SUM OF MOLE FRACTIONS		1.14275	1.15863	1.04266	1.04786	1.08005	1.21960	1.14221	

G-3

G-4

GTSIO-520-K S/N 220015 TEST 4 BASELINE (20 DEG BTC) RUNS 22-28 03/23/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED HP	CID	EXHAUST C - H FORMULA	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3		PERCENT
30.385	62.00	57.50	2.1250	62.00	435.00	520.00	3.000 5.550	0.893

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	22.	23.	24.	25.	26.	27.	28.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.60	18.60	303.00	224.00	93.00	18.60	12.20	
INDUCTION AIR FLOW (W)	LB/HR	159.00	222.00	3088.00	2355.00	1122.00	239.00	141.00	
HYDROCARBON CONC.	PPM-C W	21000.00	8250.00	2070.00	2025.00	1545.00	6450.00	21750.00	
OXIDES OF NITROGEN CONC	PPM W	14.00	42.00	32.00	48.50	350.00	40.00	9.00	
CARBON MONOXIDE CONC.	PERCENT	8.40	9.95	13.75	13.05	7.30	9.55	9.20	
CARBON DIOXIDE CONC.	PERCENT	8.95	8.75	6.35	6.90	10.45	8.95	8.25	
OXYGEN CONC.	PERCENT	1.50	0.38	0.0	0.0	0.0	0.25	1.50	
WET CORRECTION FACTOR	--	0.85008	0.85008	0.85427	0.85008	0.85351	0.85008	0.85008	
PROP. TORQUE	FT-LB	60.00	115.00	947.00	846.00	519.00	111.00	53.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.50	13.70	44.50	36.50	24.00	13.30	14.70	
INDUCTION AIR TEMP	DEG F	61.00	61.00	67.00	67.00	65.00	65.00	64.00	
COOLING AIR TEMP	DEG F	70.00	72.00	72.00	73.00	74.00	70.00	70.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	284.00	350.00	424.00	399.00	346.00	333.00	339.00	
EXHAUST GAS TEMP	DEG F			[EGT NOT MEASURED]					
INDUCTION F/A RATIO (D)	LB/LB	0.07996	0.08454	0.09901	0.09597	0.08363	0.07853	0.08730	0.08587 TA
IND. F/A EQUIV. RATIO	--	1.20	1.26	1.48	1.44	1.25	1.17	1.31	1.28 TA
ENGINE OBSERVED POWER	HP	6.85	19.71	408.95	328.77	171.35	19.02	6.05	
OBS BMEP	PSI	11.60	22.23	183.09	163.56	100.34	21.46	10.25	
OBS BSFC	LBM/BHP-HR	1.838	0.944	0.741	0.681	0.543	0.978	2.015	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.53967	0.89970	3.53857	2.59133	0.92047	0.71844	1.52950	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.22462	0.04565	0.00865	0.00788	0.00537	0.03777	0.25261	
HC MASS / MODE	LB	0.02566	0.16495	0.01769	0.21594	0.09205	0.03592	0.02549	0.57770
HC MASS / RATED HP	LB/HP								0.00133
HC - PERCENT OF EPA STANDARD									69.90
CO EMISSION RATE	LB/HR	10.56900	18.62154	405.35938	286.58643	74.93695	18.25505	11.10265	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.54190	0.94493	0.99122	0.87170	0.43733	0.95972	1.83368	
CO MASS / MODE	LB	0.17615	3.41395	2.02680	23.88220	7.49369	0.91275	0.18504	38.09056
CO MASS / RATED HP	LB/HP								0.08756
CO - PERCENT OF EPA STANDARD									208.49
NOX EMISSION RATE	LB/HR	0.00340	0.01519	0.18139	0.20580	0.69144	0.01477	0.00210	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00050	0.00077	0.00044	0.00063	0.00404	0.00078	0.00035	
NOX MASS / MODE	LB	0.00006	0.00278	0.00091	0.01715	0.06914	0.00074	0.00003	0.09082
NOX MASS / RATED HP	LB/HP								0.00021
NOX- PERCENT OF EPA STANDARD									13.92

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09267	0.09333	0.10517	0.10189	0.08367	0.09177	0.09591	0.09281 TA
DIFF. CALC & MEAS F/A	PERCENT	15.90	10.40	6.23	6.16	0.05	16.86	9.85	8.08 TA
DIFF EV & CB RATE	PERCENT	2.44	1.60	0.05	0.08	0.05	2.82	1.05	
SUM OF MOLE FRACTIONS		1.15526	1.11258	1.04519	1.05376	1.03277	1.14919	1.09487	

GTSIO-520-K S/N 220015 TEST 5 LEANOUT (20 DEG BTC) RUNS 29-35 03/29/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.995	77.00	72.00	2.1250	77.00	435.00	520.00	3.000 5.550	1.547

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3
RUN NUMBER	--	29.	30.	31.	32.	33.	34.	35.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	11.00	0.30	0.30
FUEL FLOW	LB/HR	12.00	9.60	18.50	14.40	16.10	300.00	290.00
INDUCTION AIR FLOW (W)	LB/HR	133.00	132.00	216.00	216.00	212.00	2965.00	2975.00
HYDROCARBON CONC.	PPM-C W	22500.00	14250.00	6450.00	6150.00	6375.00	1980.00	1680.00
OXIDES OF NITROGEN CONC	PPM W	10.00	27.00	36.00	92.50	70.00	26.00	41.00
CARBON MONOXIDE CONC.	PERCENT	8.10	5.00	8.95	3.00	6.00	13.60	12.75
CARBON DIOXIDE CONC.	PERCENT	8.85	10.70	9.45	12.30	11.00	6.50	7.05
OXYGEN CONC.	PERCENT	1.50	1.25	0.13	0.13	0.13	0.0	0.0
WET CORRECTION FACTOR	--	0.85029	0.83937	0.83937	0.83937	0.83937	0.85960	0.85485
PROP. TORQUE	FT-LB	48.00	50.00	105.00	106.00	108.00	909.00	930.00
PROP. SPEED	RPM	600.00	600.00	900.00	900.00	900.00	2268.00	2268.00
MFLD PRESSURE	IN HG ABS DRY	14.40	14.40	13.20	13.40	13.40	44.50	44.50
INDUCTION AIR TEMP	DEG F	74.00	74.00	75.00	76.00	76.00	80.00	80.00
COOLING AIR TEMP	DEG F	80.00	80.00	80.00	80.00	80.00	83.00	83.00
COOLING AIR DELTA P	IN H20	0.0	0.0	0.0	0.0	0.0	6.00	6.00
MAX CYL HEAD TEMP	DEG F	290.00	335.00	320.00	369.00	380.00	405.00	416.00
EXHAUST GAS TEMP	DEG F	695.00	712.00	851.00	916.00	880.00	1471.00	1499.00
INDUCTION F/A RATIO (D)	LB/LB	0.09164	0.07387	0.08699	0.06771	0.07714	0.10277	0.09901
IND. F/A EQUIV. RATIO	--	1.37	1.11	1.30	1.01	1.15	1.54	1.48
ENGINE OBSERVED POWER	HP	5.48	5.71	17.99	18.16	18.51	392.54	401.61
OBS BMEP	PSI	9.28	9.67	20.30	20.49	20.88	175.74	179.80
OBS BSFC	LBM/BHP-HR	2.188	1.681	1.028	0.793	0.870	0.764	0.722
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.58867	0.91844	0.72711	0.64519	0.67504	3.33237	2.79430
BRAKE SPECIFIC HC	LBM/BHP-HR	0.28971	0.16079	0.04041	0.03552	0.03647	0.00849	0.00696
HC MASS / MODE	LB	0.02648	0.01531	0.13330	0.11828	0.12376	0.01666	0.01397
CO EMISSION RATE	LB/HR	9.81727	5.46065	17.09634	5.33301	10.76568	397.20142	385.97266
BRAKE SPECIFIC CO	LBM/BHP-HR	1.79029	0.95598	0.95016	0.29360	0.58170	1.01188	0.91127
CO MASS / MODE	LB	0.16362	0.09101	3.13433	0.97772	1.97371	1.98601	1.82986
NOX EMISSION RATE	LB/HR	0.00234	0.00577	0.01346	0.03218	0.02458	0.14510	0.22613
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00043	0.00101	0.00075	0.00177	0.00133	0.00037	0.00056
NOX MASS / MODE	LB	0.00004	0.00010	0.00247	0.00590	0.00451	0.00073	0.00113
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09324	0.08176	0.09034	0.07634	0.08296	0.10426	0.10065
DIFF. CALC & MEAS F/A	PERCENT	1.75	10.67	3.85	12.73	7.55	1.45	1.66
DIFF EV & CB RATE	PERCENT	0.05	1.42	0.32	2.02	1.22	0.05	0.05
SUM OF MOLE FRACTIONS		1.04498	1.07660	1.05948	1.06064	1.06831	1.03479	1.03775

G-5

GTSIO-520-K S/N 220015 TEST 5A LEANOUT (20 DEG BTC) RUNS 36-42 03/29/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.995	77.00	72.00	2.1250	77.00	435.00	520.00	3.000	5.550	1.547

	UNITS	MODE 3	MODE 4	MODE 4	MODE 4	MODE 4	MODE 5	MODE 5
RUN NUMBER	--	36.	37.	38.	39.	40.	41.	42.
TIME IN MODE	MINUTES	0.30	5.00	5.00	5.00	5.00	6.00	6.00
FUEL FLOW	LB/HR	280.00	225.00	210.00	200.00	190.00	91.00	85.00
INDUCTION AIR FLOW (W)	LB/HR	2966.00	2278.00	2248.00	2267.00	2256.00	1196.00	1216.00
HYDROCARBON CONC.	PPM-C W	1545.00	2145.00	1695.00	1455.00	1260.00	1545.00	1245.00
OXIDES OF NITROGEN CONC	PPM W	53.00	36.00	67.50	106.25	168.75	335.00	920.00
CARBON MONOXIDE CONC.	PERCENT	12.25	13.15	11.80	10.65	9.45	6.80	3.65
CARBON DIOXIDE CONC.	PERCENT	7.35	6.80	7.70	8.45	9.25	10.55	12.25
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.84874	0.85507	0.84851	0.83949	0.83937	0.83937	0.83937
PROP. TORQUE	FT-LB	940.00	813.00	833.00	845.00	850.00	500.00	505.00
PROP. SPEED	RPM	2268.00	2041.00	2041.00	2041.00	2041.00	1734.00	1734.00
MFLD PRESSURE	IN HG ABS DRY	44.50	36.50	36.50	36.50	36.50	24.00	24.00
INDUCTION AIR TEMP	DEG F	80.00	79.00	79.00	78.00	78.00	78.00	79.00
COOLING AIR TEMP	DEG F	83.00	83.00	82.00	82.00	82.00	82.00	82.00
COOLING AIR DELTA P	IN H2O	6.00	6.00	6.00	6.00	6.00	6.00	6.00
MAX CYL HEAD TEMP	DEG F	426.00	366.00	380.00	398.00	413.00	320.00	330.00
EXHAUST GAS TEMP	DEG F	1520.00	1396.00	1440.00	1485.00	1527.00	1418.00	1488.00
INDUCTION F/A RATIO (D)	LB/LB	0.09589	0.10032	0.09488	0.08961	0.08554	0.07728	0.07100
IND. F/A EQUIV. RATIO	—	1.43	1.50	1.42	1.34	1.28	1.16	1.06
ENGINE OBSERVED POWER	HP	405.93	315.94	323.72	328.38	330.32	165.08	166.73
CBS BMEP	PSI	181.73	157.18	161.05	163.37	164.33	96.67	97.63
CBS BSFC	LBM/BHP-HR	0.690	0.712	0.649	0.609	0.575	0.551	0.510
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	2.52608	2.73534	2.08777	1.76331	1.48343	0.93658	0.77022
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00622	0.00867	0.00645	0.00537	0.00449	0.00567	0.00462
HC MASS / MODE	LB	0.01263	0.22828	0.17398	0.14694	0.12362	0.09366	0.07702
CO EMISSION RATE	LB/HR	343.17700	285.89014	248.96344	218.73492	188.52400	69.84941	38.26286
BRAKE SPECIFIC CO	LBM/BHP-HR	0.84542	0.91754	0.76908	0.66611	0.57073	0.42312	0.22949
CO MASS / MODE	LB	1.71588	24.15750	20.74695	18.22791	15.71033	6.98494	3.82629
NOX EMISSION RATE	LB/HR	0.28734	0.15245	0.27569	0.42697	0.65879	0.67339	1.88730
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00071	0.00048	0.00085	0.00130	0.00199	0.00408	0.01132
NOX MASS / MODE	LB	0.00144	0.01270	0.02297	0.03558	0.05490	0.06734	0.18873
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09875	0.10248	0.09704	0.09301	0.08716	0.08268	0.07524
DIFF. CALC & MEAS F/A	PERCENT	2.99	2.15	2.27	3.80	4.23	6.98	5.97
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.39	1.05	0.82
SUM OF MOLE FRACTIONS		1.04147	1.03882	1.04394	1.05081	1.06130	1.05997	1.03218

G-6

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G-7

GTSIO-520-K S/N 220015 TEST 58 LEANOUT (20 DEG BTC) RUNS 43-45 03/29/76

PBARO	TORY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.995	77.00	72.00	2.1250	77.00	435.00	520.00	3.000	5.550	1.547

	UNITS	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	43.	44.	45.				
TIME IN MODE	MINUTES	6.00	6.00	6.00				
FUEL FLOW	LB/HR	80.00	75.00	70.00				
INDUCTION AIR FLOW (W)	LB/HR	1191.00	1196.00	1191.00				
HYDROCARBON CONC.	PPM-C W	1095.00	510.00	45.00				
OXIDES OF NITROGEN CONC	PPM W	1387.50	2125.00	2125.00				
CARBON MONOXIDE CONC.	PERCENT	2.30	0.45	0.05				
CARBON DIOXIDE CONC.	PERCENT	12.90	13.65	13.35				
OXYGEN CONC.	PERCENT	0.0	0.25	1.25				
WET CORRECTION FACTOR	--	0.83937	0.83937	0.83937				
PROP. TORQUE	FT-LB	499.00	488.00	449.00				
PROP. SPEED	RPM	1734.00	1734.00	1734.00				
MFLD PRESSURE	IN HG ABS DRY	24.00	24.00	24.00				
INDUCTION AIR TEMP	DEG F	78.00	78.00	78.00				
COOLING AIR TEMP	DEG F	81.00	81.00	81.00				
COOLING AIR DELTA P	IN H2O	6.00	6.00	6.00				
MAX CYL HEAD TEMP	DEG F	334.00	335.00	325.00				
EXHAUST GAS TEMP	DEG F	1525.00	1587.00	1583.00				
INDUCTION F/A RATIO (D)	LB/LB	0.06823	0.06369	0.05970				
IND. F/A EQUIV. RATIO	--	1.02	0.95	0.89				
ENGINE OBSERVED POWER	HP	164.75	161.12	148.24				
OBS BMEP	PSI	96.47	94.35	86.81				
OBS BSFC	LBM/BHP-HR	0.486	0.465	0.472				
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.66743	0.31550	0.02745				
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00405	0.00196	0.00019				
HC MASS / MODE	LB	0.06674	0.03155	0.00274				
CO EMISSION RATE	LB/HR	23.75516	4.71718	0.51675				
BRAKE SPECIFIC CO	LBM/BHP-HR	0.14419	0.02928	0.00349				
CO MASS / MODE	LB	2.37551	0.47172	0.05168				
NOX EMISSION RATE	LB/HR	2.80435	4.35911	4.29776				
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.01702	0.02706	0.02899				
NOX MASS / MODE	LB	0.28043	0.43591	0.42978				
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.07229	0.06735	0.06320				
DIFF. CALC & MEAS F/A	PERCENT	5.95	5.75	5.87				
DIFF EV & CB RATE	PERCENT	0.69	0.34	0.10				
SUM OF MOLE FRACTIONS		1.01577	0.99097	0.99448				

GTSIO-520-K S/N 220015 TEST 6 LEANOUT (15 DEG BTC) RUNS 46-52 03/31/76

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.933	62.50	61.00	2.1250	62.50	435.00	520.00	3.000 5.550	1.093

	UNITS	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 4	MODE 4
RUN NUMBER	--	46.	47.	48.	49.	50.	51.	52.
TIME IN MODE	MINUTES	1.00	1.00	11.00	11.00	11.00	5.00	5.00
FUEL FLOW	LB/HR	12.10	9.80	19.50	17.20	15.10	231.00	220.00
INDUCTION AIR FLOW (W)	LB/HR	153.00	153.00	267.00	263.00	271.00	2332.00	2292.00
HYDROCARBON CONC.	PPM-C W	19500.00	11100.00	4575.00	5250.00	4350.00	1980.00	1800.00
OXIDES OF NITROGEN CONC	PPM W	13.00	27.00	45.00	66.00	96.00	41.50	52.00
CARBON MONOXIDE CONC.	PERCENT	8.55	5.70	9.55	5.85	3.55	12.85	12.50
CARBON DIOXIDE CONC.	PERCENT	9.15	10.65	9.15	11.20	12.50	6.95	7.30
OXYGEN CONC.	PERCENT	1.13	1.00	0.0	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.84682	0.84682	0.84682	0.84682	0.84682	0.86266	0.85549
PROP. TORQUE	FT-LB	47.00	44.00	108.00	100.00	100.00	797.00	807.00
PROP. SPEED	RPM	600.00	600.00	900.00	900.00	900.00	2041.00	2041.00
MFLD PRESSURE	IN HG ABS DRY	14.50	14.80	18.80	13.30	13.70	36.50	36.50
INDUCTION AIR TEMP	DEG F	64.00	64.00	64.00	63.00	63.00	68.00	68.00
COOLING AIR TEMP	DEG F	79.00	79.00	79.00	75.00	73.00	71.00	72.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX CYL HEAD TEMP	DEG F	312.00	357.00	380.00	327.00	389.00	387.00	392.00
EXHAUST GAS TEMP	DEG F	790.00	730.00	868.00	904.00	940.00	1455.00	1469.00
INDUCTION F/A RATIO (D)	LB/LB	0.07990	0.06476	0.07384	0.06612	0.05634	0.10015	0.09705
IND. F/A EQUIV. RATIO	--	1.20	0.97	1.10	0.99	0.84	1.50	1.45
ENGINE OBSERVED POWER	HP	5.37	5.03	18.51	17.14	17.14	309.73	313.61
CBS BMEP	PSI	9.09	8.51	20.88	19.33	19.33	154.09	156.02
CBS BSFC	LBM/BHP-HR	2.254	1.950	1.054	1.004	0.881	0.746	0.702
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.36568	0.71311	0.53683	0.59166	0.45912	2.59522	2.26794
BRAKE SPECIFIC HC	LBM/BHP-HR	0.25435	0.14187	0.02901	0.03453	0.02679	0.00838	0.00723
HC MASS / MODE	LB	0.02276	0.01189	0.09842	0.10847	0.08417	0.21627	0.18900
CO EMISSION RATE	LB/HR	10.23663	6.26017	19.15677	11.27052	6.40536	293.31860	272.00195
BRAKE SPECIFIC CO	LBM/BHP-HR	1.90648	1.24539	1.03510	0.65770	0.37379	0.94703	0.86732
CO MASS / MODE	LB	0.17061	0.10434	3.51207	2.06626	1.17432	24.44321	22.66682
NOX EMISSION RATE	LB/HR	0.00302	0.00575	0.01751	0.02466	0.03360	0.18037	0.21726
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00056	0.00114	0.00095	0.00144	0.00196	0.00058	0.00069
NOX MASS / MODE	LB	0.00005	0.00010	0.00321	0.00452	0.00616	0.01503	0.01810
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09330	0.08214	0.09138	0.08228	0.07659	0.10133	0.09948
DIFF. CALC & MEAS F/A	PERCENT	16.68	26.84	23.75	24.44	35.96	1.17	2.51
DIFF EV & CB RATE	PERCENT	2.68	4.52	4.07	4.43	6.21	0.05	0.05
SUM OF MOLE FRACTIONS		1.16409	1.21088	1.19979	1.19359	1.26525	1.03428	1.04655

G-8

GTSIO-520-K S/N 220015 TEST 6A LEANOUT (15 DEG BTC) RUNS 53-59 03/31/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3		PERCENT
29.933	62.50	61.00	2.1250	62.50	435.00	520.00	3.000 5.550	1.093

	UNITS	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4
RUN NUMBER	--	53.	54.	55.	56.	57.	58.	59.
TIME IN MODE	MINUTES	5.00	5.00	5.00	5.00	5.00	5.00	5.00
FUEL FLOW	LB/HR	210.00	200.00	190.00	180.00	170.00	160.00	150.00
INDUCTION AIR FLOW (W)	LB/HR	2262.00	2262.00	2262.00	2262.00	2232.00	2211.00	2231.00
HYDROCARBON CONC.	PPM-C W	1560.00	1410.00	1185.00	1005.00	975.00	787.50	525.00
OXIDES OF NITROGEN CONC	PPM W	77.50	106.25	190.00	375.00	550.00	1125.00	1987.00
CARBON MONOXIDE CONC.	PERCENT	11.40	10.60	9.05	7.25	5.65	4.25	1.90
CARBON DIOXIDE CONC.	PERCENT	7.90	8.65	9.55	10.60	11.10	12.10	9.75
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.85411	0.84682	0.84682	0.84682	0.84682	0.84682	0.86854
PROP. TORQUE	FT-LB	826.00	828.00	838.00	843.00	845.00	844.00	833.00
PROP. SPEED	RPM	2041.00	2041.00	2041.00	2041.00	2041.00	2041.00	2041.00
MFLD PRESSURE	IN HG ABS DRY	36.50	36.50	36.50	36.50	36.50	36.50	36.50
INDUCTION AIR TEMP	DEG F	68.00	68.00	68.00	68.00	69.00	69.00	69.00
COOLING AIR TEMP	DEG F	73.00	74.00	74.00	75.00	75.00	75.00	75.00
COOLING AIR DELTA P	IN H2O	4.00	4.00	4.00	4.00	4.00	5.00	5.00
MAX CYL HEAD TEMP	DEG F	403.00	412.00	427.00	443.00	455.00	445.00	443.00
EXHAUST GAS TEMP	DEG F	1500.00	1532.00	1581.00	1636.00	1662.00	1718.00	1771.00
INDUCTION F/A RATIO (D)	LB/LB	0.09386	0.08939	0.08492	0.08045	0.07701	0.07317	0.06798
IND. F/A EQUIV. RATIO	--	1.40	1.34	1.27	1.20	1.15	1.09	1.02
ENGINE OBSERVED POWER	HP	320.99	321.77	325.66	327.60	328.38	327.99	323.72
CBS BMEP	PSI	159.69	160.08	162.01	162.98	163.37	163.17	161.05
CBS BSFC	LBM/BHP-HR	0.654	0.622	0.583	0.549	0.518	0.488	0.463
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.93015	1.68150	1.39099	1.16558	1.13785	0.88718	0.75910
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00601	0.00523	0.00427	0.00356	0.00347	0.00270	0.00234
HC MASS / MODE	LB	0.16085	0.14013	0.11592	0.09713	0.09482	0.07393	0.06326
CO EMISSION RATE	LB/HR	243.20442	216.10240	181.60559	143.74396	112.72050	81.85083	48.16890
BRAKE SPECIFIC CO	LBM/BHP-HR	0.75766	0.67160	0.55766	0.43878	0.34326	0.24955	0.14880
CO MASS / MODE	LB	20.26703	18.00853	15.13380	11.97866	9.39337	6.82090	4.01407
NOX EMISSION RATE	LB/HR	0.31796	0.42016	0.73955	1.44216	2.12838	4.20260	9.52668
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00099	0.00131	0.00227	0.00440	0.00648	0.01281	0.02943
NOX MASS / MODE	LB	0.02650	0.03501	0.06163	0.12018	0.17736	0.35022	0.79389
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09571	0.09244	0.08789	0.08310	0.07967	0.07618	0.07246
DIFF. CALC & MEAS F/A	PERCENT	1.97	3.41	3.49	3.29	3.46	4.12	6.59
DIFF EV & CB RATE	PERCENT	0.05	0.21	0.44	0.55	0.40	0.65	0.05
SUM OF MOLE FRACTIONS		1.04057	1.06298	1.06314	1.05899	1.02537	1.03774	0.80056

GTSIO-520-K S/N 220015 TEST 6B LEANOUT (15 DEG BTC) RUNS 60-64 03/31/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.933	62.50	61.00	2.1250	62.50	435.00	520.00	3.000 5.550	1.093

	UNITS	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5	MODE 0	MODE 0
RUN NUMBER	--	60.	61.	62.	63.	64.		
TIME IN MODE	MINUTES	6.00	6.00	6.00	6.00	6.00		
FUEL FLOW	LB/HR	92.00	85.00	80.00	75.00	70.00		
INDUCTION AIR FLOW (W)	LB/HR	1148.00	1148.00	1148.00	1145.00	1145.00		
HYDROCARBON CONC.	PPM-C W	1410.00	1200.00	1035.00	339.00	34.50		
OXIDES OF NITROGEN CONC	PPM W	310.00	775.00	1625.00	2025.00	2037.50		
CARBON MONOXIDE CONC.	PERCENT	6.95	4.10	2.20	0.40	0.05		
CARBON DIOXIDE CONC.	PERCENT	10.65	12.10	13.20	13.90	13.90		
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.13	0.63		
WET CORRECTION FACTOR	--	0.84682	0.84682	0.84682	0.85098	0.84682		
PROP. TORQUE	FT-LB	487.00	485.00	476.00	463.00	437.00		
PROP. SPEED	RPM	1734.50	1734.00	1734.00	1734.00	1734.00		
MFLD PRESSURE	IN HG ABS DRY	24.00	24.00	24.00	24.00	24.00		
INDUCTION AIR TEMP	DEG F	67.00	67.00	67.00	68.00	68.00		
COOLING AIR TEMP	DEG F	74.00	75.00	76.00	75.00	75.00		
COOLING AIR DELTA P	IN H2O	4.00	4.00	4.00	4.00	4.00		
MAX CYL HEAD TEMP	DEG F	343.00	348.00	355.00	358.00	355.00		
EXHAUST GAS TEMP	DEG F	1456.00	1511.00	1564.00	1632.00	1642.00		
INDUCTION F/A RATIO (D)	LB/LB	0.08103	0.07486	0.07046	0.06623	0.06181		
IND. F/A EQUIV. RATIO	--	1.21	1.12	1.05	0.99	0.92		
ENGINE OBSERVED POWER	HP	160.83	160.13	157.16	152.86	144.28		
OBS BMEP	PSI	94.15	93.77	92.03	89.51	84.49		
OBS BSFC	LBM/BHP-HR	0.572	0.531	0.509	0.491	0.485		
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.84533	0.72264	0.61758	0.19886	0.02004		
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00526	0.00451	0.00393	0.00130	0.00014		
HC MASS / MODE	LB	0.08453	0.07226	0.06176	0.01989	0.00200		
CO EMISSION RATE	LB/HR	71.23048	42.20854	22.44162	4.14099	0.49643		
BRAKE SPECIFIC CO	LBM/BHP-HR	0.44288	0.26359	0.14280	0.02709	0.00344		
CO MASS / MODE	LB	7.12305	4.22085	2.24416	0.41410	0.04964		
NOX EMISSION RATE	LB/HR	0.61627	1.54757	3.21526	4.04644	3.92393		
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00383	0.00966	0.02046	0.02647	0.02720		
NOX MASS / MODE	LB	0.06163	0.15476	0.32153	0.40464	0.39239		
** DATA VALIDITY CHECKS FOR ENGLO7 **								
CAL. FUEL AIR RATIO	LB/LB	0.08274	0.07613	0.07195	0.06753	0.06514		
DIFF. CALC & MEAS F/A	PERCENT	2.11	1.70	2.12	1.97	5.39		
DIFF EV & CB RATE	PERCENT	0.24	0.10	0.11	0.05	0.40		
SUM OF MOLE FRACTIONS		1.04118	1.01361	1.00671	0.98052	1.00461		

G-10

GTSIO-520-K S/N 220015 TEST 7 LEANOUT (30 DEG BTC) RUNS 65-71 04/02/76

PBARO	IDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.252	69.50	59.00	2.1250	69.50	435.00	520.00	3.000	5.550	0.815

	UNITS	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 4
RUN NUMBER	--	65.	66.	67.	68.	69.	70.	71.
TIME IN MODE	MINUTES	1.00	1.00	1.00	11.00	11.00	11.00	5.00
FUEL FLOW	LB/HR	11.80	8.30	9.60	18.20	15.80	13.40	226.00
INDUCTION AIR FLOW (W)	LB/HR	151.00	149.00	141.00	221.00	216.00	216.00	2397.00
HYDROCARBON CONC.	PPM-C W	33750.00	16500.00	17250.00	8250.00	6000.00	5850.00	1875.00
OXIDES OF NITROGEN CONC	PPM W	8.50	40.00	25.00	35.00	77.50	143.70	46.00
CARBON MONOXIDE CONC.	PERCENT	7.95	2.05	6.05	9.60	6.70	2.80	12.60
CARBON DIOXIDE CONC.	PERCENT	7.45	10.35	9.15	8.00	9.75	11.45	6.35
OXYGEN CONC.	PERCENT	3.75	3.50	2.50	1.50	1.50	1.87	1.00
WET CORRECTION FACTOR	--	0.85134	0.85134	0.85134	0.85134	0.85134	0.85134	0.86754
PROP. TORQUE	FT-LB	55.00	49.00	53.00	104.00	110.00	105.00	841.00
PROP. SPEED	RPM	600.00	600.00	600.00	900.00	900.00	900.00	2041.00
MFLD PRESSURE	IN HG ABS DRY	14.30	14.80	14.10	13.00	13.00	13.10	36.50
INDUCTION AIR TEMP	DEG F	66.00	66.00	67.00	67.00	67.00	67.00	75.00
COOLING AIR TEMP	DEG F	75.00	75.00	75.00	73.00	70.00	70.00	76.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX CYL HEAD TEMP	DEG F	263.00	346.00	355.00	333.00	365.00	380.00	401.00
EXHAUST GAS TEMP	DEG F	633.00	655.00	630.00	776.00	783.00	838.00	1365.00
INDUCTION F/A RATIO (D)	LB/LB	0.07879	0.05616	0.06864	0.08303	0.07375	0.06259	0.09506
IND. F/A EQUIV. RATIO	--	1.18	0.84	1.03	1.24	1.10	0.94	1.42
ENGINE OBSERVED POWER	HP	6.28	5.60	6.05	17.82	18.85	17.99	326.82
OBS BMEP	PSI	10.63	9.47	10.25	20.11	21.27	20.30	162.59
OBS BSFC	LBM/BHP-HR	1.878	1.483	1.586	1.021	0.838	0.745	0.692
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	2.36842	1.09995	1.10707	0.93119	0.63640	0.60436	2.49860
BRAKE SPECIFIC HC	LBM/BHP-HR	0.37694	0.19650	0.18284	0.05225	0.03376	0.03359	0.00765
HC MASS / MODE	LB	0.03947	0.01833	0.01845	0.17072	0.11667	0.11080	0.20822
CO EMISSION RATE	LB/HR	9.58831	2.34874	6.67317	18.62292	12.21356	4.97153	294.06250
BRAKE SPECIFIC CO	LBM/BHP-HR	1.52599	0.41958	1.10212	1.04495	0.64794	0.27630	0.89976
CO MASS / MODE	LB	0.15981	0.03915	0.11122	3.41420	2.23915	0.91145	24.50520
NOX EMISSION RATE	LB/HR	0.00198	0.00884	0.00532	0.01310	0.02726	0.04923	0.20326
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00031	0.00158	0.00088	0.00074	0.00145	0.00274	0.00062
NOX MASS / MODE	LB	0.00003	0.00015	0.00009	0.00240	0.00500	0.00902	0.01694
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09255	0.06961	0.08224	0.08950	0.08026	0.07023	0.09785
DIFF. CALC & MEAS F/A	PERCENT	17.46	23.95	19.80	7.79	8.83	12.29	2.93
DIFF EV & CB RATE	PERCENT	1.81	2.92	2.70	0.59	1.16	1.63	0.05
SUM OF MOLE FRACTIONS		1.13954	1.10844	1.13490	1.07305	1.08179	1.06701	1.03523

G-11

AD-A069 012 TELEDYNE CONTINENTAL MOTORS MOBILE AL AIRCRAFT PRODU--ETC F/G 21/7
EXHAUST EMISSIONS CHARACTERISTICS OF FIVE AIRCRAFT PISTON ENGIN--ETC(U)
MAR 79 K J STUCKAS DOT-FA74NA-1091
UNCLASSIFIED FAA/RD-78-88 NL

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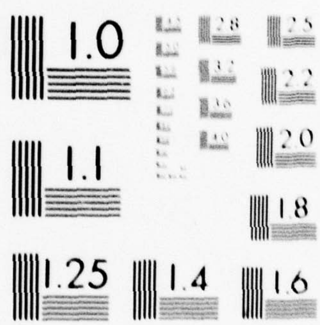

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

GTSIO-520-K S/N 220015 TEST 7A LEANOUT (30 DEG BTC) RUNS 72-78 04/02/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.252	69.50	59.00	2.1250	69.50	435.00	520.00	3.000 5.550	0.815

	UNITS	MODE 4	MODE 4	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5
RUN NUMBER	--	72.	73.	74.	75.	76.	77.	78.
TIME IN MODE	MINUTES	5.00	5.00	6.00	6.00	6.00	6.00	6.00
FUEL FLOW	LB/HR	210.00	195.00	91.00	85.00	80.00	75.00	70.00
INDUCTION AIR FLOW (W)	LB/HR	2377.00	2367.00	1267.00	1213.00	1213.00	1214.00	1214.00
HYDROCARBON CONC.	PPM-C W	1530.00	1275.00	1470.00	1230.00	1095.00	825.00	315.00
OXIDES OF NITROGEN CONC	PPM W	89.00	180.00	500.00	1087.00	1850.00	2850.00	3250.00
CARBON MONOXIDE CONC.	PERCENT	11.50	9.90	6.90	4.25	2.60	0.75	0.20
CARBON DIOXIDE CONC.	PERCENT	7.55	8.85	10.55	11.75	12.80	13.50	13.50
OXYGEN CONC.	PERCENT	0.38	0.0	0.0	0.13	0.13	0.25	0.88
WET CORRECTION FACTOR	--	0.85134	0.85134	0.85134	0.85134	0.85134	0.85134	0.85134
PROP. TORQUE	FT-LB	854.00	849.00	521.00	523.00	516.00	512.00	491.00
PROP. SPEED	RPM	2041.00	2041.00	1734.00	1734.00	1734.00	1734.00	1734.00
MFLD PRESSURE	IN HG ABS DRY	36.50	36.50	24.00	24.00	24.00	24.00	24.00
INDUCTION AIR TEMP	DEG F	76.00	76.00	74.00	75.00	74.00	74.00	75.00
COOLING AIR TEMP	DEG F	76.00	78.00	76.00	76.00	79.00	79.00	79.00
COOLING AIR DELTA P	IN H2O	6.00	6.00	6.00	6.00	6.00	6.00	6.00
MAX CYL HEAD TEMP	DEG F	430.00	456.00	340.00	345.00	350.00	350.00	348.00
EXHAUST GAS TEMP	DEG F	1421.00	1487.00	1377.00	1428.00	1466.00	1501.00	1510.00
INDUCTION F/A RATIO (D)	LB/LB	0.08907	0.08306	0.07241	0.07065	0.06649	0.06229	0.05813
IND. F/A EQUIV. RATIO	--	1.33	1.24	1.08	1.06	0.99	0.93	0.87
ENGINE OBSERVED POWER	HP	331.88	329.93	172.01	172.67	170.36	169.06	162.11
OBS BMEP	PSI	165.11	164.14	100.73	101.11	99.76	98.99	94.93
OBS BSFC	LBM/BHP-HR	0.633	0.591	0.529	0.492	0.470	0.444	0.432

CARBON BALANCE MASS EMISSIONS

	UNITS							
HC EMISSION RATE	LB/HR	1.92417	1.51493	0.87416	0.74577	0.64964	0.49866	0.18485
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00580	0.00459	0.00508	0.00432	0.00381	0.00294	0.00114
HC MASS / MODE	LB	0.16035	0.12624	0.08742	0.07458	0.06496	0.04967	0.01849
CO EMISSION RATE	LB/HR	248.56470	202.16621	70.52028	44.28729	26.51097	7.75996	2.01712
BRAKE SPECIFIC CO	LBM/BHP-HR	0.74897	0.61275	0.40997	0.25648	0.15562	0.04591	0.01244
CO MASS / MODE	LB	20.71371	16.84718	7.05203	4.42873	2.65110	0.77600	0.20171
NOX EMISSION RATE	LB/HR	0.37115	0.70919	0.98594	2.18542	3.63949	5.68930	6.32413
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00112	0.00215	0.00573	0.01266	0.02136	0.03366	0.03901
NOX MASS / MODE	LB	0.03093	0.05910	0.09859	0.21854	0.36395	0.56893	0.63241

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS							
CAL. FUEL AIR RATIO	LB/LB	0.09508	0.09072	0.08280	0.07623	0.07247	0.06814	0.06481
DIFF. CALC & MEAS F/A	PERCENT	6.74	9.23	14.34	7.90	8.99	9.40	11.48
DIFF. EV & CB RATE	PERCENT	0.42	1.42	2.64	1.29	1.51	1.25	1.46
SUM OF MOLE FRACTIONS		1.05988	1.09030	1.12058	1.04675	1.05331	1.02386	1.03941

GTSIO-520-K S/N 220015 TEST 78 LEANOUT (30 DEG BTC) RUN 79 04/02/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.252	69.50	59.00	2.1250	69.50	435.00	520.00	3.000 5.550	0.815

	UNITS	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	79.						
TIME IN MODE	MINUTES	6.00						
FUEL FLOW	LB/HR	65.00						
INDUCTION AIR FLOW (W)	LB/HR	1215.00						
HYDROCARBON CONC.	PPM-C W	120.00						
OXIDES OF NITROGEN CONC	PPM W	3000.00						
CARBON MONOXIDE CONC.	PERCENT	0.05						
CARBON DIOXIDE CONC.	PERCENT	12.50						
OXYGEN CONC.	PERCENT	2.37						
WET CORRECTION FACTOR	--	0.85134						
PROP. TORQUE	FT-LB	454.00						
PROP. SPEED	RPM	1734.00						
PFLD PRESSURE	IN HG ABS DRY	24.00						
INDUCTION AIR TEMP	DEG F	75.00						
COOLING AIR TEMP	DEG F	79.00						
COOLING AIR DELTA P	IN H2O	6.00						
MAX CYL HEAD TEMP	DEG F	334.00						
EXHAUST GAS TEMP	DEG F	1464.00						
INDUCTION F/A RATIO (D)	LB/LB	0.05394						
IND. F/A EQUIV. RATIO	--	0.81						
ENGINE OBSERVED POWER	HP	145.89						
CBS BMEP	PSI	87.77						
CBS BSFC	LBM/BHP-HR	0.434						
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.07149						
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00048						
HC MASS / MODE	LB	0.00715						
CO EMISSION RATE	LB/HR	0.51197						
BRAKE SPECIFIC CO	LBM/BHP-HR	0.00342						
CO MASS / MODE	LB	0.05120						
NOX EMISSION RATE	LB/HR	5.92672						
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.03954						
NOX MASS / MODE	LB	0.59267						
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.05974						
DIFF. CALC & MEAS F/A	PERCENT	10.76						
DIFF EV & CB RATE	PERCENT	0.78						
SUM OF MOLE FRACTIONS		1.02050						

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GTSIO-520-K S/N 220015 TEST 8 LEANOUT (40 DEG BTC) RUNS 80-86 04/05/76

PBARC	TDRY	TMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.988	73.50	65.00	2.1250	73.50	435.00	520.00	3.000 , 5.550	1.110

	UNITS	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2	MODE 4
RUN NUMBER	--	80.	81.	82.	83.	84.	85.	86.
TIME IN MODE	MINUTES	1.00	1.00	1.00	11.00	11.00	11.00	5.00
FUEL FLOW	LB/HR	12.00	10.00	7.80	18.80	15.70	13.00	225.00
INDUCTION AIR FLOW (W)	LB/HR	171.00	171.00	166.00	251.00	251.00	241.00	2304.00
HYDROCARBON CONC.	PPM-C W	52500.00	27750.00	24000.00	5850.00	4690.00	4650.00	1950.00
OXIDES OF NITROGEN CONC	PPM W	7.00	22.00	65.00	31.00	90.00	218.75	48.00
CARBON MONOXIDE CONC.	PERCENT	7.70	6.25	1.75	10.80	7.45	2.95	13.25
CARBON DIOXIDE CONC.	PERCENT	6.80	8.75	10.35	8.20	10.15	12.50	6.60
OXYGEN CONC.	PERCENT	5.00	3.13	4.37	0.13	0.0	0.25	0.0
WET CORRECTION FACTOR	--	0.84654	0.84654	0.84654	0.84654	0.84654	0.84654	0.85502
PROP. TORQUE	FT-LB	50.00	54.00	46.00	106.00	106.00	101.00	790.00
PROP. SPEED	RPM	600.00	600.00	600.00	900.00	900.00	900.00	2041.00
MFLD PRESSURE	IN HG ABS DRY	13.90	13.50	13.80	12.90	12.90	13.10	36.50
INDUCTION AIR TEMP	DEG F	69.00	69.00	69.00	70.00	70.00	70.00	76.00
COOLING AIR TEMP	DEG F	69.00	69.00	69.00	69.00	70.00	70.00	77.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	0.0	9.10
MAX CYL HEAD TEMP	DEG F	255.00	300.00	344.00	339.00	363.00	379.00	425.00
EXHAUST GAS TEMP	DEG F	570.00	570.00	590.00	767.00	747.00	807.00	1350.00
INDUCTION F/A RATIO (D)	LB/LB	0.07096	0.05914	0.04752	0.07574	0.06325	0.05455	0.09875
IND. F/A EQUIV. RATIO	--	1.06	0.88	0.71	1.13	0.95	0.82	1.48
ENGINE OBSERVED POWER	HP	5.71	6.17	5.26	18.16	18.16	17.31	307.00
OBS BMEP	PSI	9.67	10.44	8.89	20.49	20.49	19.53	152.73
OBS BSFC	LBM/BHP-HR	2.101	1.621	1.484	1.035	0.864	0.751	0.733
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	3.52450	1.75831	1.45165	0.64686	0.46586	0.43758	2.50570
BRAKE SPECIFIC HC	LBM/BHP-HR	0.61702	0.28502	0.27623	0.03561	0.02565	0.02528	0.00816
HC MASS / MODE	LB	0.05874	0.02931	0.02419	0.11859	0.08541	0.08022	0.20881
CO EMISSION RATE	LB/HR	8.83406	6.76777	1.80892	20.40833	12.75532	4.74417	293.88110
BRAKE SPECIFIC CO	LBM/BHP-HR	1.54655	1.09705	0.34422	1.12353	0.70221	0.27411	0.95725
CO MASS / MODE	LB	0.14723	0.11280	0.03015	3.74153	2.33848	0.86976	24.49008
NOX EMISSION RATE	LB/HR	0.00156	0.00462	0.01304	0.01137	0.02990	0.06826	0.20452
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00027	0.00075	0.00248	0.00063	0.00165	0.00394	0.00067
NOX MASS / MODE	LB	0.00003	0.00008	0.00022	0.00208	0.00548	0.01251	0.01704
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.09882	0.08665	0.07045	0.09582	0.08609	0.07482	0.10326
DIFF. CALC & MEAS F/A	PERCENT	39.26	46.53	48.27	26.51	36.11	37.16	4.57
DIFF EV & CB RATE	PERCENT	4.88	6.56	6.49	4.19	6.03	6.21	0.05
SUM OF MOLE FRACTIONS		1.29540	1.33404	1.31030	1.20462	1.26870	1.25465	1.03745

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GTSIO-520-K S/N 220015 TEST 8A LEANOUT (40 DEG BTC) RUNS 87-93 04/05/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.988	73.50	65.00	2.1250	73.50	435.00	520.00	3.000	5.550	1.110

	UNITS	MODE 4	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5
RUN NUMBER	--	87.	88.	89.	90.	91.	92.	93.
TIME IN MODE	MINUTES	5.00	6.00	6.00	6.00	6.00	6.00	6.00
FUEL FLOW	LB/HR	210.00	92.00	85.00	80.00	75.00	70.00	65.00
INDUCTION AIR FLOW (W)	LB/HR	2303.00	1178.00	1178.00	1175.00	1175.00	1165.00	1205.00
HYDROCARBON CONC.	PPM-C W	1455.00	1440.00	1230.00	1125.00	930.00	682.50	211.50
OXIDES OF NITROGEN CONC	PPM W	91.00	475.00	975.00	1787.50	2990.00	3250.00	3350.00
CARBON MONOXIDE CONC.	PERCENT	11.90	7.40	4.90	3.00	1.05	0.30	0.05
CARBON DIOXIDE CONC.	PERCENT	7.65	10.35	11.50	12.65	13.40	13.50	12.60
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.50	2.50
WET CORRECTION FACTOR	--	0.84654	0.84654	0.84654	0.84654	0.84654	0.84654	0.84654
PROP. TORQUE	FT-LB	785.00	484.00	493.00	498.00	500.00	486.00	457.00
PROP. SPEED	RPM	2041.00	1734.00	1734.00	1734.00	1734.00	1734.00	1734.00
MFLD PRESSURE	IN HG ABS DRY	36.50	24.00	24.00	24.00	24.00	24.00	24.00
INDUCTION AIR TEMP	DEG F	77.00	75.00	75.00	75.00	76.00	76.00	76.00
COOLING AIR TEMP	DEG F	78.00	78.00	78.00	80.00	80.00	80.00	80.00
COOLING AIR DELTA P	IN H2O	9.10	6.00	6.00	6.00	6.00	6.00	6.00
MAX CYL HEAD TEMP	DEG F	456.00	364.00	365.00	37.00	369.00	364.00	335.00
EXHAUST GAS TEMP	DEG F	1411.00	1348.00	1402.00	1445.00	1485.00	1484.00	1416.00
INDUCTION F/A RATIO (D)	LB/LB	0.09221	0.07898	0.07297	0.06885	0.06455	0.06676	0.05455
IND. F/A EQUIV. RATIO	--	1.38	1.18	1.09	1.03	0.97	0.91	0.82
ENGINE OBSERVED POWER	HP	305.06	159.80	162.77	164.47	165.04	160.44	[illegible]
OBS BMEP	PSI	151.17	93.57	95.31	96.28	96.67	93.96	88.35
OBS BSFC	LBM/BHP-HR	0.688	0.576	0.522	0.487	0.454	0.436	0.431

CARBON BALANCE MASS EMISSIONS

HC EMISSION RATE	LB/HR	1.79431	0.85620	0.73183	0.66042	0.55482	0.39862	0.12758
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00588	0.00536	0.00450	0.00402	0.00336	0.00248	0.00085
HC MASS / MODE	LB	0.14953	0.08562	0.07318	0.06604	0.05548	0.03986	0.01276
CO EMISSION RATE	LB/HR	250.79172	75.19246	49.82365	30.09679	10.70505	2.99437	0.56697
BRAKE SPECIFIC CO	LBM/BHP-HR	0.82210	0.47055	0.30610	0.18305	0.06485	0.01866	0.00376
CO MASS / MODE	LB	20.89931	7.51924	4.98236	3.00968	1.07050	0.29944	0.05670
NOX EMISSION RATE	LB/HR	0.37212	0.93651	1.92362	3.47952	5.91486	6.29422	6.70060
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00122	0.00586	0.01182	0.02116	0.03583	0.03923	0.04441
NOX MASS / MODE	LB	0.03101	0.09365	0.19236	0.34795	0.59149	0.62942	0.67006

** DATA VALIDITY CHECKS FOR ENG107 **

CAL. FUEL AIR RATIO	LB/LB	0.09721	0.08393	0.07807	0.07373	0.06961	0.06636	0.05939
DIFF. CALC & MEAS F/A	PERCENT	5.43	6.27	7.00	7.09	7.85	9.22	8.88
DIFF EV & CB RATE	PERCENT	0.21	1.05	1.11	1.12	0.91	0.97	0.27
SUM OF MOLE FRACTIONS		1.05704	1.06934	1.04540	1.04097	1.00827	1.01079	1.00521

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GTSIO-520-K S/N 220015 TEST 8B LEANOUT (40 DEG BTC) RUN 94 04/05/76

PBARC	TDRY	TMET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.988	73.50	65.00	2.1250	73.50	435.00	520.00	3.000	5.550	1.110

	UNITS	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	94.						
TIME IN MODE	MINUTES	6.00						
FUEL FLOW	LB/HR	61.00						
INDUCTION AIR FLOW (W)	LB/HR	1210.00						
HYDROCARBON CONC.	PPM-C W	187.50						
OXIDES OF NITROGEN CONC	PPM W	2650.00						
CARBON MONOXIDE CONC.	PERCENT	0.05						
CARBON DIOXIDE CONC.	PERCENT	11.70						
OXYGEN CONC.	PERCENT	3.75						
WET CORRECTION FACTOR	--	0.84703						
PROP. TORQUE	FT-LB	430.00						
PROP. SPEED	RPM	1734.00						
MFLD PRESSURE	IN HG ABS DRY	24.00						
INDUCTION AIR TEMP	DEG F	76.00						
COOLING AIR TEMP	DEG F	80.00						
COOLING AIR DELTA P	IN H2O	6.00						
MAX CYL HEAD TEMP	DEG F	312.00						
EXHAUST GAS TEMP	DEG F	1377.00						
INDUCTION F/A RATIO (D)	LB/LB	0.05098						
IND. F/A EQUIV. RATIO	--	0.76						
ENGINE OBSERVED POWER	HP	141.97						
CBS BMEP	PSI	83.13						
CBS BSFC	LBM/BHP-HR	0.430						
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.11241						
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00079						
HC MASS / MODE	LB	0.01124						
CO EMISSION RATE	LB/HR	0.56383						
BRAKE SPECIFIC CO	LBM/BHP-HR	0.00392						
CO MASS / MODE	LB	0.05638						
NOX EMISSION RATE	LB/HR	5.26807						
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.03711						
NOX MASS / MODE	LB	0.52681						
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.05555						
DIFF. CALC & MEAS F/A	PERCENT	9.04						
DIFF EV & CB RATE	PERCENT	0.05						
SUM OF MOLE FRACTIONS		1.01124						

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GTSIO-520-K S/N 220015 TEST 9 LEANOUT (50 DEG BTC) RUNS 95-101 04/07/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
29.900	74.00	66.00	2.1250	74.00	435.00	520.00	3.000	5.990	1.160

	UNITS	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 5	MODE 0
RUN NUMBER	--	95.	96.	97.	98.	100.	101.	
TIME IN MODE	MINUTES	1.00	1.00	1.00	11.00	11.00	6.00	
FUEL FLOW	LB/HR	12.00	10.00	8.50	18.20	14.60	92.00	
INDUCTION AIR FLOW (W)	LB/HR	167.00	163.00	163.00	238.00	238.00	1176.00	
HYDROCARBON CONC.	PPM-C W	52500.00	39000.00	33750.00	2500.00	2500.00	1320.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	30.00	250.00	48.00	117.50	470.00	
CARBON MONOXIDE CONC.	PERCENT	7.10	5.55	0.90	10.45	6.85	7.80	
CARBON DIOXIDE CONC.	PERCENT	6.50	7.70	9.55	8.25	6.55	10.10	
OXYGEN CONC.	PERCENT	5.87	5.00	6.50	0.38	0.38	0.0	
WET CORRECTION FACTOR	--	0.84559	0.84559	0.84559	0.84559	0.84559	0.84559	
PROP. TORQUE	FT-LB	55.00	50.00	40.00	107.00	100.00	445.00	
PROP. SPEED	RPM	600.00	600.00	600.00	900.00	900.00	1734.00	
PELD PRESSURE	IN HG ABS DRY	14.90	15.00	15.00	12.70	12.50	26.00	
INDUCTION AIR TEMP	DEG F	70.00	71.00	71.00	72.00	73.00	75.00	
COOLING AIR TEMP	DEG F	79.30	79.00	79.00	78.00	78.00	80.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	6.00	
MAX CYL HEAD TEMP	DEG F	243.00	285.00	322.00	325.00	378.00	382.00	
EXHAUST GAS TEMP	DEG F	495.00	507.00	546.00	724.00	922.00	1357.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07271	0.06207	0.05276	0.07737	0.06207	0.07916	
IND. F/A EQUIV. RATIO	--	1.09	0.93	0.79	1.16	0.93	1.18	
ENGINE OBSERVED POWER	HP	6.28	5.71	4.57	18.34	17.14	146.92	
OBS BMEP	PSI	10.63	9.67	7.73	20.69	19.33	86.03	
OBS BSFC	LBM/BHP-HR	1.910	1.751	1.860	0.993	0.852	0.626	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 5
HC EMISSION RATE	LB/HR	3.68751	2.53190	2.30321	0.80800	0.88863	0.77980
BRAKE SPECIFIC HC	LBM/BHP-HR	0.58687	0.44318	0.50402	0.04407	0.05186	0.00531
HC MASS / MODE	LB	0.06146	0.04219	0.03839	0.14813	0.16292	0.07798
CO EMISSION RATE	LB/HR	8.51294	6.14971	1.04846	19.21834	13.85477	78.65993
BRAKE SPECIFIC CO	LBM/BHP-HR	1.35485	1.07661	0.22944	1.04813	0.80850	0.53539
CO MASS / MODE	LB	0.14188	0.10250	0.01747	3.52336	2.54004	7.86599
NOX EMISSION RATE	LB/HR	0.00210	0.00646	0.05657	0.01715	0.04616	0.92870
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00033	0.00113	0.01238	0.00094	0.00269	0.00627
NOX MASS / MODE	LB	0.00003	0.00011	0.00094	0.00314	0.00846	0.09287

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 5
CAL. FUEL AIR RATIO	LB/LB	0.09476	0.08590	0.06757	0.09493	0.09248	0.08492
DIFF. CALC & MEAS F/A	PERCENT	30.33	38.38	28.06	22.69	49.00	7.28
DIFF EV & CB RATE	PERCENT	3.29	4.79	2.96	3.53	4.99	1.20
SUM OF MOLE FRACTIONS		1.22235	1.25370	1.16821	1.17913	1.00995	1.07561

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GTSIO-520-K S/N 220015 TEST 9A LEANOUT (50 DEG BTC) RUNS 102-107 04/07/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.900	74.00	66.00	2.1250	74.00	435.00	520.00	3.000	5.550	1.168

	UNITS	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5	MODE 0
RUN NUMBER	--	102.	103.	104.	105.	106.	107.	
TIME IN MODE	MINUTES	6.00	6.00	6.00	6.00	6.00	6.00	
FUEL FLOW	LB/HR	85.00	80.00	75.00	70.00	65.00	60.00	
INDUCTION AIR FLOW (W)	LB/HR	1165.00	1162.00	1149.00	1155.00	1165.00	1165.00	
HYDROCARBON CONC.	PPM-C W	1125.00	1020.00	900.00	555.00	337.50	265.00	
OXIDES OF NITROGEN CONC	PPM W	1100.00	1850.00	3050.00	3400.00	3400.00	3300.00	
CARBON MONOXIDE CONC.	PERCENT	4.75	3.10	1.10	0.15	0.05	0.05	
CARBON DIOXIDE CONC.	PERCENT	11.65	12.40	13.30	13.40	12.90	11.65	
OXYGEN CONC.	PERCENT	0.0	0.0	0.25	0.75	1.87	3.75	
WET CORRECTION FACTOR	--	0.84559	0.84559	0.84559	0.84559	0.84559	0.84907	
PROP. TORQUE	FT-LB	451.00	461.00	466.00	461.00	457.00	435.00	
PROP. SPEED	RPM	1734.00	1734.00	1734.00	1734.00	1734.00	1734.00	
PFLD PRESSURE	IN HG ABS DRY	24.00	24.00	24.00	24.00	24.00	24.00	
INDUCTION AIR TEMP	DEG F	76.00	76.00	76.00	76.00	77.00	77.00	
COOLING AIR TEMP	DEG F	80.00	80.00	80.00	81.00	82.00	82.00	
COOLING AIR DELTA P	IN H2O	6.00	6.00	6.00	6.00	6.00	6.00	
MAX CYL HEAD TEMP	DEG F	389.00	388.00	384.00	373.00	355.00	320.00	
EXHAUST GAS TEMP	DEG F	1411.00	1448.00	1467.00	1475.00	1431.00	1352.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07382	0.06966	0.06605	0.06132	0.05645	0.05123	
IND. F/A EQUIV. RATIO	--	1.10	1.04	0.99	0.92	0.84	0.77	
ENGINE OBSERVED POWER	HP	148.90	152.20	153.85	152.20	150.88	143.62	
CBS BMEP	PSI	87.19	89.13	90.09	89.13	88.35	84.10	
CBS BSFC	LBM/BHP-HR	0.571	0.526	0.487	0.460	0.431	0.418	
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.67060	0.60567	0.53950	0.33083	0.19573	0.15585	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00450	0.00398	0.00351	0.00217	0.00130	0.00109	
HC MASS / MODE	LB	0.06706	0.06057	0.05395	0.03308	0.01957	0.01558	
CO EMISSION RATE	LB/HR	48.33424	31.42307	11.25612	1.52632	0.54450	0.55653	
BRAKE SPECIFIC CO	LBM/BHP-HR	0.32460	0.20645	0.07316	0.01003	0.00361	0.00388	
CO MASS / MODE	LB	4.83342	3.14231	1.12561	0.15263	0.05445	0.05565	
NOX EMISSION RATE	LB/HR	2.17427	3.64265	6.06254	6.72037	6.53842	6.45972	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.01460	0.02393	0.03940	0.04415	0.04333	0.04498	
NOX MASS / MODE	LB	0.21743	0.36426	0.60625	0.67204	0.65384	0.64597	
** DATA VALIDITY CHECKS FOR ENG102 **								
CAL. FUEL AIR RATIO	LB/LB	0.07762	0.07399	0.06891	0.06520	0.06145	0.05559	
DIFF. CALC & MEAS F/A	PERCENT	5.14	6.21	4.34	6.33	8.86	8.51	
DIFF EV & CB RATE	PERCENT	0.74	0.80	0.14	0.24	0.51	0.05	
SUM OF MOLE FRACTIONS		1.03578	1.02137	0.98947	0.98688	1.01313	1.00756	

G-18

GTSIO-520-K S/N 220015 TEST 10 BASELINE 20 RUNS 108-114 04/08/76

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
29.963	80.00	61.00	2.1250	80.00	435.00	520.00	3.000 5.550	0.704

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	108.	109.	110.	111.	112.	113.	114.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	11.80	18.50	302.00	220.00	89.00	18.10	11.80	
INDUCTION AIR FLOW (W)	LB/HR	178.00	246.00	2935.00	2243.00	1189.00	255.00	172.00	
HYDROCARBON CONC.	PPM-C W	30000.00	9600.00	1965.00	1875.00	1515.00	6000.00	30000.00	
OXIDES OF NITROGEN CONC	PPM W	11.00	40.00	32.00	51.00	400.00	45.00	11.00	
CARBON MONOXIDE CONC.	PERCENT	8.20	9.65	13.90	13.55	7.00	9.10	8.90	
CARBON DIOXIDE CONC.	PERCENT	8.35	8.80	6.35	6.85	10.65	9.35	8.15	
OXYGEN CONC.	PERCENT	2.50	0.50	0.0	0.0	0.0	0.13	2.00	
WET CORRECTION FACTOR	--	0.85314	0.85314	0.86998	0.85737	0.85314	0.85314	0.85314	
PROP. TORQUE	FT-LB	49.00	100.00	910.00	812.00	495.00	97.00	49.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MELD PRESSURE	IN HG ABS DRY	14.50	13.50	44.50	36.50	26.00	13.10	14.60	
INDUCTION AIR TEMP	DEG F	79.00	79.00	85.00	83.00	83.00	82.00	82.00	
COOLING AIR TEMP	DEG F	89.00	89.00	93.00	93.00	91.00	86.00	86.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	275.00	348.00	445.00	418.00	362.00	292.00	333.00	
EXHAUST GAS TEMP	DEG F	700.00	835.00	1470.00	1421.00	1430.00	902.00	700.00	
INDUCTION F/A RATIO (D)	LB/LB	0.06676	0.07574	0.10363	0.09878	0.07538	0.07148	0.06909	0.07915 TA
IND. F/A EQUIV. RATIO	--	1.00	1.13	1.55	1.48	1.13	1.07	1.03	1.18 TA
ENGINE OBSERVED POWER	HP	5.60	17.14	392.97	315.55	163.43	16.62	5.60	
OBS BMEP	PSI	9.47	19.33	175.93	156.99	95.70	18.75	9.47	
OBS BSFC	LBM/BHP-HR	2.108	1.080	0.769	0.697	0.545	1.089	2.108	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	2.02731	1.04261	3.26608	2.28772	0.86915	0.65159	1.97802	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.36216	0.06084	0.00831	0.00725	0.00532	0.03920	0.35335	
HC MASS / MODE	LB	0.03379	0.19115	0.01633	0.19064	0.08692	0.03258	0.03297	0.58437
HC MASS / RATED HP	LB/HP								0.00134
HC - PERCENT OF EPA STANDARD									70.70
CO EMISSION RATE	LB/HR	9.54380	18.05042	405.76489	286.15137	69.16574	17.02048	10.10669	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.70490	1.05334	1.03256	0.90682	0.42322	1.02396	1.80545	
CO MASS / MODE	LB	0.15906	3.30924	2.02882	23.84595	6.91657	0.85102	0.16844	37.27908
CO MASS / RATED HP	LB/HP								0.08570
CO - PERCENT OF EPA STANDARD									204.05
NOX EMISSION RATE	LB/HR	0.00246	0.01441	0.17637	0.20634	0.76094	0.01620	0.00240	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00044	0.00084	0.00045	0.00065	0.00466	0.00097	0.00043	
NOX MASS / MODE	LB	0.00004	0.00264	0.00088	0.01719	0.07609	0.00081	0.00004	0.09770
NOX MASS / RATED HP	LB/HP								0.00022
NOX- PERCENT OF EPA STANDARD									14.97

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09427	0.09292	0.10535	0.10283	0.08288	0.09048	0.09802	0.09263 TA
DIFF. CALC & MEAS F/A	PERCENT	41.20	22.69	1.66	4.10	9.94	26.57	41.87	17.04 TA
DIFF EV & CB RATE	PERCENT	6.03	3.77	0.05	0.05	1.93	4.58	6.11	
SUM OF MOLE FRACTIONS		1.33092	1.15704	1.03753	1.06253	1.10165	1.22380	1.32578	

GTSIO-520-K S/N 220015 TEST 11 80% POWER,RPM & MAP VAR RUNS 115-121 04/13/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIC	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.164	79.00	70.00	2.1250	79.00	435.00	520.00	3.000 5.550	1.347

	UNITS	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4
RUN NUMBER	--	115.	116.	117.	118.	119.	120.	121.
TIME IN MODE	MINUTES	5.00	5.00	5.00	5.00	5.00	5.00	5.00
FUEL FLOW	LB/HR	238.00	236.00	238.00	230.00	224.00	220.00	220.00
INDUCTION AIR FLOW (W)	LB/HR	2276.00	2281.00	2258.00	2244.00	2257.00	2260.00	2347.00
HYDROCARBON CONC.	PPM-C W	2490.00	2595.00	2730.00	2550.00	2130.00	2025.00	1950.00
OXIDES OF NITROGEN CONC	PPM W	20.00	19.00	17.50	22.50	37.50	45.00	56.00
CARBON MONOXIDE CONC.	PERCENT	13.85	13.95	14.10	13.85	13.15	12.80	12.40
CARBON DIOXIDE CONC.	PERCENT	6.20	6.15	6.05	6.20	6.80	6.95	7.05
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.86897	0.86467	0.86912	0.86256	0.85839	0.85521	0.84664
PROP. TORQUE	FT-LB	970.00	922.00	870.00	835.00	820.00	810.00	780.00
PROP. SPEED	RPM	1754.00	1800.00	1867.00	1934.00	2001.00	2041.00	2134.00
MFLD PRESSURE	IN HG ABS DRY	44.50	42.50	40.30	38.50	37.00	36.50	35.50
INDUCTION AIR TEMP	DEG F	84.00	84.00	84.00	84.00	84.00	84.00	84.00
COOLING AIR TEMP	DEG F	88.00	88.00	87.00	88.00	88.00	88.00	88.00
COOLING AIR DELTA P	IN H2O	4.00	4.00	4.00	4.00	4.00	4.00	4.00
MAX CYL HEAD TEMP	DEG F	375.00	368.00	355.00	366.00	385.00	394.00	408.00
EXHAUST GAS TEMP	DEG F	1386.00	1372.00	1371.00	1377.00	1405.00	1424.00	1450.00
INDUCTION F/A RATIO (O)	LB/LB	0.10600	0.10488	0.10684	0.10389	0.10060	0.09867	0.09902
INC. F/A EQUIV. RATIO	--	1.59	1.57	1.60	1.55	1.51	1.48	1.42
ENGINE OBSERVED POWER	HP	323.95	315.99	309.27	307.48	312.42	314.78	316.93
OBS BMEP	PSI	187.53	178.25	168.20	161.43	158.53	156.60	150.80
OBS BSFC	LBM/BHP-HR	0.735	0.747	0.770	0.748	0.717	0.699	0.694
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	3.28779	3.40390	3.58161	3.27654	2.69799	2.55528	2.52425
BRAKE SPECIFIC HC	LBM/BHP-HR	0.01015	0.01077	0.01158	0.01066	0.00864	0.00812	0.00796
HC MASS / MODE	LB	0.27398	0.28366	0.29847	0.27304	0.22483	0.21294	0.21035
CO EMISSION RATE	LB/HR	320.80762	319.41016	324.56226	309.88550	288.64063	278.85913	274.35156
BRAKE SPECIFIC CO	LBM/BHP-HR	0.99030	1.01081	1.04944	1.00782	0.92389	0.88589	0.86565
CO MASS / MODE	LB	26.73396	26.61751	27.04684	25.82379	24.05338	23.23825	22.86263
NOX EMISSION RATE	LB/HR	0.08757	0.08264	0.07613	0.09587	0.15751	0.18829	0.24038
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00027	0.00026	0.00025	0.00031	0.00050	0.00060	0.00076
NOX MASS / MODE	LB	0.00730	0.00689	0.00634	0.00799	0.01313	0.01569	0.02003
** DATA VALIDITY CHECKS FOR ENGL07 **								
CAL. FUEL AIR RATIO	LB/LB	0.10619	0.10664	0.10741	0.10624	0.10246	0.10128	0.10021
DIFF. CALC & MEAS F/A	PERCENT	0.18	1.69	0.53	2.25	1.85	2.64	5.46
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.02205	1.02705	1.02301	1.02814	1.03805	1.03668	1.03639

GTSIO-520-K S/N 220015 TEST 11A 40% POWER,RPM & MAP VAR RUNS 122,123 04/13/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.164	79.00	70.00	2.1250	79.00	435.00	520.00	3.000	5.550	1.347

	UNITS	MODE 5	MODE 5	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	122.	123.					
TIME IN MODE	MINUTES	6.00	6.00					
FUEL FLOW	LB/HR	88.00	92.00					
INDUCTION AIR FLOW (W)	LB/HR	1132.00	1180.00					
HYDROCARBON CONC.	PPM-C W	1575.00	1605.00					
OXIDES OF NITROGEN CONC	PPM W	270.00	290.00					
CARBON MONOXIDE CONC.	PERCENT	7.20	7.25					
CARBON DIOXIDE CONC.	PERCENT	10.45	10.45					
OXYGEN CONC.	PERCENT	0.0	0.0					
WET CORRECTION FACTOR	--	0.84266	0.84266					
PROP. TORQUE	FT-LB	530.00	505.00					
PROP. SPEED	RPM	1600.00	1734.00					
MFLD PRESSURE	IN HG ABS DRY	25.70	24.00					
INDUCTION AIR TEMP	DEG F	81.00	82.00					
COOLING AIR TEMP	DEG F	86.00	87.00					
COOLING AIR DELTA P	IN H2O	4.00	4.00					
MAX CYL HEAD TEMP	DEG F	330.00	339.00					
EXHAUST GAS TEMP	DEG F	1412.00	1421.00					
INDUCTION F/A RATIO (D)	LB/LB	0.07880	0.07903					
IND. F/A EQUIV. RATIO	--	1.18	1.18					
ENGINE OBSERVED POWER	HP	161.46	166.73					
OBS BMEP	PSI	102.47	97.63					
OBS BSFC	LBM/BHP-HR	0.545	0.552					
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.90407	0.96028					
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00560	0.00576					
HC MASS / MODE	LB	0.09041	0.09603					
CO EMISSION RATE	LB/HR	70.30571	73.79031					
BRAKE SPECIFIC CO	LBM/BHP-HR	0.43543	0.44257					
CO MASS / MODE	LB	7.03057	7.37903					
NOX EMISSION RATE	LB/HR	0.51391	0.57534					
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00318	0.00345					
NOX MASS / MODE	LB	0.05139	0.05753					
** DATA VALIDITY CHECKS FOR ENGL07 **								
CAL. FUEL AIR RATIO	LB/LB	0.08353	0.08363					
DIFF. CALC & MEAS F/A	PERCENT	6.00	5.82					
DIFF EV & CB RATE	PERCENT	0.95	0.93					
SUM OF MOLE FRACTIONS		1.06447	1.06542					

GTSIO-520-K S/N 220015 TEST 118 IND AIR PRESSURE VAR. RUNS 124-130 04/13/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.164	79.00	70.00	2.1250	79.00	435.00	520.00	3.000 5.550	1.347

	UNITS	MODE 1	MODE 1	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2
RUN NUMBER	--	124.	125.	126.	127.	128.	129.	130.
TIME IN MODE	MINUTES	1.00	1.00	1.00	1.00	1.00	11.00	11.00
FUEL FLOW	LB/HR	12.50	12.70	11.70	11.30	12.10	17.80	18.80
INDUCTION AIR FLOW (W)	LB/HR	170.00	155.00	141.00	125.00	101.00	237.00	237.00
HYDROCARBON CONC.	PPM-C W	16500.00	19500.00	24000.00	27600.00	27000.00	5550.00	9000.00
OXIDES OF NITROGEN CONC	PPM W	13.00	13.00	10.00	10.00	11.00	40.00	36.00
CARBON MONOXIDE CONC.	PERCENT	7.40	7.80	8.10	7.80	8.40	8.55	9.60
CARBON DIOXIDE CONC.	PERCENT	9.34	8.95	8.75	8.35	8.00	9.45	8.65
OXYGEN CONC.	PERCENT	1.25	1.50	1.50	2.13	2.00	0.0	0.25
WET CORRECTION FACTOR	--	0.84266	0.84266	0.84266	0.85624	0.94557	0.84266	0.84266
PROP. TORQUE	FT-LB	48.00	50.00	46.00	45.00	45.00	104.00	100.00
PROP. SPEED	RPM	600.00	600.00	600.00	600.00	600.00	900.00	900.00
PFLD PRESSURE	IN HG ABS DRY	14.00	14.50	14.50	14.80	15.00	13.00	13.50
INDUCTION AIR TEMP	DEG F	80.00	80.00	82.00	79.00	79.00	80.00	80.00
COOLING AIR TEMP	DEG F	80.00	80.00	80.00	80.00	80.00	80.00	80.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX CYL HEAD TEMP	DEG F	255.00	260.00	268.00	260.00	310.00	288.00	365.00
EXHAUST GAS TEMP	DEG F	721.00	685.00	740.00	720.00	667.00	872.00	838.00
INDUCTION F/A RATIO (D)	LB/LB	0.07453	0.08305	0.08411	0.09163	0.12144	0.07613	0.08041
IND. F/A EQUIV. RATIO	--	1.12	1.24	1.26	1.37	1.82	1.14	1.20
ENGINE OBSERVED POWER	HP	5.48	5.71	5.26	5.14	5.14	17.82	17.14
CBS BMEP	PSI	9.28	9.67	8.89	8.70	8.70	20.11	19.33
CBS BSFC	LBM/BHP-HR	2.280	2.223	2.226	2.198	2.354	0.999	1.097
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	1.28338	1.51140	1.65855	1.84330	1.75919	0.61601	1.01905
BRAKE SPECIFIC HC	LBM/BHP-HR	0.23404	0.26460	0.31561	0.35856	0.34219	0.03457	0.05947
HC MASS / MODE	LB	0.02139	0.02519	0.02764	0.03072	0.02932	0.11294	0.18683
CO EMISSION RATE	LB/HR	9.79129	10.28435	9.52229	9.00455	10.44736	16.14363	18.49101
BRAKE SPECIFIC CO	LBM/BHP-HR	1.78555	1.80045	1.81199	1.75155	2.03221	0.90584	1.07905
CO MASS / MODE	LB	0.16319	0.17141	0.15870	0.15008	0.17412	2.95967	3.39002
NOX EMISSION RATE	LB/HR	0.00335	0.00334	0.00229	0.00221	0.00238	0.01472	0.01352
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00061	0.00058	0.00044	0.00043	0.00046	0.00083	0.00079
NOX MASS / MODE	LB	0.00006	0.00006	0.00004	0.00004	0.00004	0.00270	0.00248
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.08895	0.09098	0.09442	0.09389	0.09441	0.08967	0.09400
DIFF. CALC & MEAS F/A	PERCENT	19.35	9.54	12.26	2.46	-22.26	17.79	16.90
DIFF EV & CB RATE	PERCENT	2.95	0.99	1.47	0.05	0.05	2.96	2.56
SUM OF MOLE FRACTIONS		1.14804	1.08041	1.09982	1.03469	0.94638	1.13493	1.12683

GTSIO-520-K S/N 220015 TEST 11C IND AIR PRESSURE VAR. RUNS 131-137 04/13/76

PBARC IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA		H2O IN AIR PERCENT
30.178	79.50	69.50	2.1250	79.50	435.00	520.00	3.000	5.550	1.298

	UNITS	MODE 2	MODE 2	MODE 2	MODE 3	MODE 3	MODE 3	MODE 3
RUN NUMBER	--	131.	132.	133.	134.	135.	136.	137.
TIME IN MODE	MINUTES	11.00	11.00	11.00	0.30	0.30	0.30	0.30
FUEL FLOW	LB/HR	18.80	18.80	19.10	300.00	300.00	300.00	300.00
INDUCTION AIR FLOW (W)	LB/HR	234.00	216.00	205.00	2976.00	2974.00	2961.00	2959.00
HYDROCARBON CONC.	PPM-C W	6000.00	7050.00	6000.00	2325.00	2160.00	2130.00	2130.00
OXIDES OF NITROGEN CONC	PPM W	42.00	40.00	40.00	22.00	25.00	26.00	26.50
CARBON MONOXIDE CONC.	PERCENT	8.55	9.25	9.10	13.90	13.70	13.60	13.60
CARBON DIOXIDE CONC.	PERCENT	9.55	9.05	9.35	6.20	6.35	6.50	6.50
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.84346	0.84346	0.86353	0.85773	0.85976	0.86192	0.86213
PROP. TORQUE	FT-LB	100.00	98.00	105.00	864.00	885.00	902.00	903.00
PROP. SPEED	RPM	900.00	900.00	900.00	2268.00	2268.00	2268.00	2268.00
MFLD PRESSURE	IN HG ABS DRY	13.50	13.70	13.50	44.00	44.40	44.50	44.50
INDUCTION AIR TEMP	DEG F	80.00	79.00	78.00	84.00	84.00	84.00	84.00
COOLING AIR TEMP	DEG F	0.0	0.0	0.0	88.00	88.00	88.00	88.00
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	4.00	4.00	4.00	4.00
MAX CYL HEAD TEMP	DEG F	300.00	358.00	304.00	420.00	425.00	428.00	431.00
EXHAUST GAS TEMP	DEG F	886.00	961.00	858.00	1476.00	1484.00	1484.00	1483.00
INDUCTION F/A RATIO (D)	LB/LB	0.08140	0.08818	0.09440	0.10213	0.10220	0.10265	0.10272
IND. F/A EQUIV. RATIO	--	1.22	1.32	1.41	1.53	1.53	1.54	1.54
ENGINE OBSERVED POWER	HP	17.14	16.79	17.99	373.11	382.17	389.92	389.95
OBS BMEP	PSI	19.33	18.95	20.30	167.04	171.10	174.39	174.58
OBS BSFC	LBM/BHP-HR	1.097	1.119	1.062	0.804	0.785	0.770	0.769
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.69700	0.80509	0.67962	3.91371	3.63983	3.57224	3.57135
BRAKE SPECIFIC HC	LBM/BHP-HR	0.04067	0.04794	0.03777	0.01049	0.00952	0.00917	0.00916
HC MASS / MODE	LB	0.12778	0.14760	0.12460	0.01957	0.01820	0.01786	0.01786
CO EMISSION RATE	LB/HR	16.91214	17.98651	17.96877	405.15137	400.69556	396.87354	396.87500
BRAKE SPECIFIC CO	LBM/BHP-HR	0.98692	1.07103	0.99865	1.08589	1.04846	1.01889	1.01777
CO MASS / MODE	LB	3.10056	3.29753	3.29427	2.02576	2.00348	1.98437	1.98437
NOX EMISSION RATE	LB/HR	0.01618	0.01515	0.01502	0.12280	0.13969	0.14459	0.14733
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00094	0.00090	0.00083	0.00033	0.00037	0.00037	0.00038
NOX MASS / MODE	LB	0.00297	0.00278	0.00275	0.00061	0.00070	0.00072	0.00074
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.08974	0.09250	0.09096	0.10620	0.10513	0.10435	0.10435
DIFF. CALC & MEAS F/A	PERCENT	10.25	4.90	-3.64	3.98	2.87	1.66	1.59
DIFF. EV & CB RATE	PERCENT	1.63	0.40	0.05	0.05	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.09039	1.04723	1.02567	1.03484	1.03355	1.03557	1.03537

GTSIO-520-K S/N 220015 TEST 11D IND AIR PRESSURE VAR. RUNS 138-144 04/14/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
30.204	78.00	72.00	2.1250	78.00	435.00	520.00	3.000	5.550	1.524

	UNITS	MODE 3	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4	MODE 4
RUN NUMBER	--	138.	139.	140.	141.	142.	143.	144.
TIME IN MODE	MINUTES	0.30	5.00	5.00	5.00	5.00	5.00	5.00
FUEL FLOW	LB/HR	302.00	226.00	228.00	225.00	225.00	225.00	222.00
INDUCTION AIR FLOW (W)	LB/HR	2956.00	2331.00	2309.00	2288.00	2286.00	2293.00	2273.00
HYDROCARBON CONC.	PPM-C W	2070.00	2295.00	2370.00	2220.00	2220.00	2175.00	2130.00
OXIDES OF NITROGEN CONC	PPM W	28.00	35.00	32.00	38.00	37.00	40.00	44.00
CARBON MONOXIDE CONC.	PERCENT	13.50	13.15	13.30	12.95	13.05	12.95	12.70
CARBON DIOXIDE CONC.	PERCENT	6.55	6.80	6.70	6.95	6.85	6.95	6.80
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WET CORRECTION FACTOR	--	0.86350	0.84901	0.85360	0.85525	0.85480	0.85464	0.85560
PROP. TORQUE	FT-LB	915.00	805.00	805.00	812.00	816.00	820.00	828.00
PROP. SPEED	RPM	2268.00	2041.00	2041.00	2041.00	2041.00	2041.00	2041.00
MFLD PRESSURE	IN HG ABS DRY	44.50	36.50	36.50	36.50	36.50	36.50	36.50
INDUCTION AIR TEMP	DEG F	84.00	80.00	82.00	82.00	82.00	82.00	82.00
COOLING AIR TEMP	DEG F	87.00	81.00	81.00	81.00	81.00	81.00	81.00
COOLING AIR DELTA P	IN H2O	4.00	4.00	4.00	4.00	4.00	4.00	4.00
MAX CYL HEAD TEMP	DEG F	430.00	385.00	382.00	385.00	383.00	386.00	388.00
EXHAUST GAS TEMP	DEG F	1487.00	1412.00	1407.00	1414.00	1407.00	1418.00	1426.00
INDUCTION F/A RATIO (D)	LB/LB	0.10375	0.09845	0.10027	0.09986	0.09995	0.09964	0.09918
IND. F/A EQUIV. RATIO	--	1.55	1.47	1.50	1.49	1.50	1.49	1.48
ENGINE OBSERVED POWER	HP	395.13	312.83	312.83	315.55	317.11	318.66	321.77
OBS BMEP	PSI	176.90	155.63	155.63	156.99	157.76	158.53	160.08
OBS BSFC	LBM/BHP-HR	0.764	0.722	0.729	0.713	0.710	0.706	0.690
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	3.49824	2.96208	3.06069	2.84032	2.84181	2.78546	2.74362
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00885	0.00947	0.00978	0.00900	0.00896	0.00874	0.00853
HC MASS / MODE	LB	0.01749	0.24684	0.25506	0.23669	0.23682	0.23212	0.22864
CO EMISSION RATE	LB/HR	397.70386	250.89844	295.98120	286.06592	288.27271	286.13794	282.55811
BRAKE SPECIFIC CO	LBM/BHP-HR	1.00651	0.92588	0.94613	0.90655	0.90907	0.89793	0.87813
CO MASS / MODE	LB	1.98852	24.24153	24.66510	23.83882	24.02272	23.84482	23.54651
NOX EMISSION RATE	LB/HR	0.15691	0.14979	0.13703	0.16121	0.15705	0.16987	0.18793
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00040	0.00048	0.00044	0.00051	0.00050	0.00053	0.00058
NOX MASS / MODE	LB	0.00078	0.01248	0.01142	0.01343	0.01309	0.01416	0.01566
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.10395	0.10258	0.10323	0.10165	0.10217	0.10163	0.10168
DIFF. CALC & MEAS F/A	PERCENT	0.19	4.19	2.95	1.79	2.22	1.99	2.52
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUM OF MOLE FRACTIONS		1.03057	1.04481	1.04065	1.03964	1.03850	1.04020	1.02359

GTSIO-520-K S/N 220015 TEST 11E IND AIR PRESSURE VAR. RUNS 145-150 04/14/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA		PERCENT
30.204	78.00	72.00	2.1250	78.00	435.00	520.00	3.000	5.550	1.524

	UNITS	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5	MODE 5	MODE 0
RUN NUMBER	--	145.	146.	147.	148.	149.	150.	
TIME IN MODE	MINUTES	6.00	6.00	6.00	6.00	6.00	6.00	
FUEL FLOW	LB/HR	95.00	93.00	92.00	92.00	92.00	92.00	
INDUCTION AIR FLOW (W)	LB/HR	1174.00	1182.00	1186.00	1169.00	1163.00	1153.00	
HYDROCARBON CONC.	PPM-C W	1755.00	1680.00	1665.00	1665.00	1635.00	1650.00	
OXIDES OF NITROGEN CONC	PPM W	202.50	265.00	275.00	275.00	310.00	290.00	
CARBON MONOXIDE CONC.	PERCENT	8.25	7.40	7.25	7.25	7.00	7.20	
CARBON DIOXIDE CONC.	PERCENT	10.05	10.55	10.55	10.55	10.80	10.65	
OXYGEN CONC.	PERCENT	0.0	0.0	0.0	0.0	0.0	0.0	
WET CORRECTION FACTOR	--	0.83974	0.83974	0.83974	0.83974	0.83974	0.83974	
PROP. TORQUE	FT-LB	500.00	508.00	510.00	511.00	511.00	508.00	
PROP. SPEED	RPM	1734.00	1734.00	1734.00	1734.00	1734.00	1734.00	
MFLD PRESSURE	IN HG ABS DRY	24.00	24.00	24.00	24.00	24.00	24.00	
INDUCTION AIR TEMP	DEG F	79.00	79.00	79.00	79.00	80.00	81.00	
COOLING AIR TEMP	DEG F	81.00	81.00	81.00	81.00	81.00	82.00	
COOLING AIR DELTA P	IN H2O	4.00	4.00	4.00	4.00	4.00	4.00	
MAX CYL HEAD TEMP	DEG F	338.00	336.00	338.00	335.00	340.00	340.00	
EXHAUST GAS TEMP	DEG F	1400.00	1417.00	1421.00	1421.00	1427.00	1424.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08217	0.07990	0.07877	0.07992	0.08033	0.08103	
IND. F/A EQUIV. RATIO	--	1.23	1.20	1.18	1.20	1.20	1.21	
ENGINE OBSERVED POWER	HP	165.08	167.72	168.38	168.71	168.71	167.72	
OBS BMEP	PSI	96.67	98.21	98.60	98.79	98.79	98.21	
OBS BSFC	LBM/BHP-HR	0.575	0.554	0.546	0.545	0.545	0.549	

CARBON BALANCE MASS EMISSIONS

	UNITS						
HC EMISSION RATE	LB/HR	1.05168	1.00503	0.99366	0.99366	0.97595	0.98208
BRAKE SPECIFIC HC	LBM/BHP-HR	0.00637	0.00599	0.00590	0.00589	0.00578	0.00586
HC MASS / MODE	LB	0.10517	0.10050	0.09937	0.09937	0.09759	0.09821
CO EMISSION RATE	LB/HR	83.80885	75.04672	73.34831	73.34831	70.83313	72.64784
BRAKE SPECIFIC CO	LBM/BHP-HR	0.50769	0.44745	0.43561	0.43476	0.41985	0.43315
CO MASS / MODE	LB	8.38088	7.50467	7.33483	7.33483	7.08331	7.26478
NOX EMISSION RATE	LB/HR	0.40238	0.52568	0.54420	0.54420	0.61359	0.57235
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00244	0.00313	0.00323	0.00323	0.00364	0.00341
NOX MASS / MODE	LB	0.04024	0.05257	0.05442	0.05442	0.06136	0.05724

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS						
CAL. FUEL AIR RATIO	LB/LB	0.08602	0.08381	0.08354	0.08354	0.08277	0.08331
DIFF. CALC & MEAS F/A	PERCENT	4.68	4.89	6.05	4.53	3.04	2.82
DIFF EM & CB RATE	PERCENT	0.69	0.80	1.00	0.68	0.45	0.37
SUM OF MOLE FRACTIONS		1.07110	1.07145	1.07327	1.06231	1.05830	1.05486

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GTSIO-520-K S/N 220015 TEST 12 BASELINE (20 DEG BTC) RUNS 151-157 04/14/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA	PERCENT
30.195	78.00	68.00	2.1250	78.00	435.00	520.00	3.000 5.550	1.221

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	151.	152.	153.	154.	155.	156.	157.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	11.80	19.20	298.00	222.00	92.00	18.80	11.80	
INDUCTION AIR FLOW (W)	LB/HR	139.00	265.00	2969.00	2289.00	1179.00	251.00	126.00	
HYDROCARBON CONC.	PPM-C W	25500.00	6900.00	2145.00	2100.00	1575.00	7500.00	33000.00	
OXIDES OF NITROGEN CONC	PPM W	12.00	37.50	27.50	45.00	310.00	39.00	9.00	
CARBON MONOXIDE CONC.	PERCENT	7.55	9.55	13.70	12.80	7.10	8.65	8.15	
CARBON DIOXIDE CONC.	PERCENT	9.00	9.25	6.55	7.10	10.65	9.60	8.15	
OXYGEN CONC.	PERCENT	2.25	0.38	0.0	0.0	0.0	0.25	2.50	
WET CORRECTION FACTOR	--	0.84473	0.84473	0.85871	0.85479	0.84473	0.84473	0.86157	
PROP. TORQUE	FT-LB	48.00	110.00	922.00	815.00	502.00	104.00	48.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.50	13.50	44.50	36.50	24.00	13.00	14.70	
INDUCTION AIR TEMP	DEG F	76.00	76.00	81.00	80.00	79.00	78.00	78.00	
COOLING AIR TEMP	DEG F	79.00	79.00	86.00	86.00	86.00	80.00	80.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	255.00	330.00	427.00	400.00	343.00	286.00	325.00	
EXHAUST GAS TEMP	DEG F	659.00	853.00	1482.00	1436.00	1427.00	891.00	692.00	
INDUCTION F/A RATIO (D)	LB/LB	0.08594	0.07335	0.10161	0.09818	0.07900	0.07583	0.09481	0.08097 TA
IND. F/A EQUIV. RATIO	--	1.29	1.10	1.52	1.47	1.18	1.13	1.42	1.21 TA
ENGINE OBSERVED POWER	HP	5.48	18.85	398.15	316.72	165.74	17.82	5.48	
OBS BMEP	PSI	9.28	21.27	178.25	157.57	97.05	20.11	9.28	
OBS BSFC	LBM/BHP-HR	2.152	1.019	0.748	0.701	0.555	1.055	2.152	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.78465	0.78382	3.56004	2.65423	0.93761	0.85510	2.20124	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.32545	0.04158	0.00894	0.00838	0.00566	0.04798	0.40142	
HC MASS / MODE	LB	0.02974	0.14370	0.01780	0.22119	0.09376	0.04276	0.03669	0.58563
HC MASS / RATED HP	LB/HP								0.00135
HC - PERCENT OF EPA STANDARD									70.86
CO EMISSION RATE	LB/HR	9.01076	18.49997	394.16895	279.17480	72.07837	16.81804	9.45554	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.64321	0.98143	0.99000	0.88146	0.43489	0.94368	1.72432	
CO MASS / MODE	LB	0.15018	3.39166	1.97084	23.26456	7.20784	0.84090	0.15759	36.98354
CO MASS / RATED HP	LB/HP								0.08502
CO - PERCENT OF EPA STANDARD									202.43
NOX EMISSION RATE	LB/HR	0.00278	0.01413	0.15134	0.18860	0.61194	0.01474	0.00199	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00051	0.00075	0.00038	0.00060	0.00369	0.00083	0.00036	
NOX MASS / MODE	LB	0.00005	0.00259	0.00076	0.01572	0.06119	0.00074	0.00003	0.08107
NOX MASS / RATED HP	LB/HP								0.00019
NOX- PERCENT OF EPA STANDARD									12.43

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09067	0.09091	0.10435	0.10082	0.08309	0.08961	0.09613	0.09120 TA
DIFF. CALC & MEAS F/A	PERCENT	5.51	23.95	2.69	2.68	5.19	18.18	1.40	12.63 TA
DIFF EV & CB RATE	PERCENT	0.22	4.17	0.05	0.05	0.91	3.19	0.05	
SUM OF MOLE FRACTIONS		1.08060	1.22810	1.04532	1.04599	1.06923	1.16741	1.05072	

GTSIO-520-K S/N 220015 TEST 13 BASELINE (20 DEG BTC) RUNS 158-164 04/20/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.940	81.00	69.00	2.1250	81.00	435.00	520.00	3.000	5.550	1.227

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	158.	159.	160.	161.	162.	163.	164.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	11.80	18.00	301.00	221.00	88.00	18.60	12.00	
INDUCTION AIR FLOW (W)	LB/HR	166.00	273.00	2959.00	2341.00	1147.00	282.00	130.00	
HYDROCARBON CONC.	PPM-C W	21000.00	6375.00	2205.00	2130.00	1530.00	6000.00	37500.00	
OXIDES OF NITROGEN CONC	PPM W	12.50	40.00	27.00	42.50	345.00	43.00	12.50	
CARBON MONOXIDE CONC.	PERCENT	8.60	9.80	13.70	12.95	6.95	8.55	8.10	
CARBON DIOXIDE CONC.	PERCENT	8.65	8.75	6.45	6.85	10.55	9.35	7.70	
OXYGEN CONC.	PERCENT	1.38	0.38	0.0	0.0	0.0	0.38	3.13	
WET CORRECTION FACTOR	--	0.84462	0.84462	0.86289	0.84503	0.84462	0.84462	0.85819	
PROP. TORQUE	FT-LB	50.00	105.00	902.00	805.00	495.00	105.00	50.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.30	13.50	44.50	36.50	24.00	13.20	14.60	
INDUCTION AIR TEMP	DEG F	80.00	80.00	85.00	84.00	84.00	84.00	82.00	
COOLING AIR TEMP	DEG F	91.00	97.00	90.00	91.00	93.00	95.00	95.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	320.00	380.00	432.00	400.00	360.00	333.00	335.00	
EXHAUST GAS TEMP	DEG F	785.00	843.00	1481.00	1424.00	1432.00	889.00	665.00	
INDUCTION F/A RATIO (D)	LB/LB	0.07197	0.06675	0.10299	0.09558	0.07767	0.06678	0.09345	0.07600 TA
INC. F/A EQUIV. RATIO	--	1.08	1.00	1.54	1.43	1.16	1.00	1.40	1.14 TA
ENGINE OBSERVED POWER	HP	5.71	17.99	389.52	312.83	163.43	17.99	5.71	
OBS BMEP	PSI	9.67	20.30	174.39	155.63	95.70	20.30	9.67	
OBS BSFC	LBM/BHP-HR	2.066	1.000	0.773	0.706	0.538	1.034	2.101	

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
HC EMISSION RATE	LB/HR	1.45741	0.68998	3.69554	2.72363	0.88391	0.69607	2.54883	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.25514	0.03835	0.00949	0.00871	0.00541	0.03869	0.44621	
HC MASS / MODE	LB	0.02429	0.12650	0.01848	0.22697	0.08839	0.03480	0.04248	0.56191
HC MASS / RATED HP	LB/HP								0.00129
HC - PERCENT OF EPA STANDARD									67.99
CO EMISSION RATE	LB/HR	10.17676	18.08543	399.97632	282.48682	68.46240	16.91293	9.53812	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.78161	1.00513	1.02686	0.90299	0.41891	0.93997	1.66981	
CO MASS / MODE	LB	0.16961	3.31566	1.99988	23.54056	6.84624	0.84565	0.15897	36.87656
CO MASS / RATED HP	LB/HP								0.08477
CO - PERCENT OF EPA STANDARD									201.84
NOX EMISSION RATE	LB/HR	0.00288	0.01436	0.15005	0.18020	0.66091	0.01654	0.00282	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00050	0.00080	0.00039	0.00058	0.00404	0.00092	0.00049	
NOX MASS / MODE	LB	0.00005	0.00263	0.00075	0.01502	0.06609	0.00083	0.00005	0.08541
NOX MASS / RATED HP	LB/HP								0.00020
NOX- PERCENT OF EPA STANDARD									13.09

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
CAL. FUEL AIR RATIO	LB/LB	0.09424	0.09206	0.10476	0.10196	0.08293	0.08854	0.09692	0.09188 TA
DIFF. CALC & MEAS F/A	PERCENT	30.95	37.91	1.72	6.68	6.76	32.60	3.70	20.88 TA
DIFF EV & CB RATE	PERCENT	4.74	6.03	0.05	0.05	1.12	5.35	0.05	
SUM OF MOLE FRACTIONS		1.23884	1.29618	1.03640	1.04786	1.06676	1.24957	1.05727	

G-27

GTSIO-520-K S/N 220015 TEST 14 BASELINE (20 DEG BTC) RUNS 165-169 05/12/76

PBARO IN HG ABS	TDRY DEG F	TWET DEG F	FUEL HYDROGEN-CARBON RATIO	TAMB DEG F	RATED HP	CID INCH**3	EXHAUST C - H FORMULA	H2O IN AIR PERCENT
30.000	81.00	74.00	2.1250	81.00	435.00	520.00	3.000 5.550	1.619

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 0	MODE 0
RUN NUMBER	--	165.	166.	167.	168.	169.		
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00		
FUEL FLOW	LB/HR	11.80	18.20	300.00	224.00	91.00		
INDUCTION AIR FLOW (W)	LB/HR	88.00	220.00	2941.00	2198.00	1178.00		
HYDROCARBON CONC.	PPM-C W	22500.00	5850.00	2175.00	2250.00	1575.00		
OXIDES OF NITROGEN CONC	PPM W	12.00	41.00	25.00	35.00	275.00		
CARBON MONOXIDE CONC.	PERCENT	8.30	9.55	13.60	13.15	7.25		
CARBON DIOXIDE CONC.	PERCENT	8.85	9.15	6.50	6.80	10.55		
OXYGEN CONC.	PERCENT	1.75	0.25	0.13	0.13	0.13		
WET CORRECTION FACTOR	--	0.98495	0.83817	0.86307	0.86614	0.83817		
PROP. TORQUE	FT-LB	1.00	1.00	1.00	1.00	1.00		
PROP. SPEED	RPM	600.00	900.00	2266.00	2041.00	1734.00		
PFLD PRESSURE	IN HG ABS DRY	14.40	13.50	44.50	36.50	24.00		
INDUCTION AIR TEMP	DEG F	81.00	81.00	87.00	86.00	84.00		
COOLING AIR TEMP	DEG F	82.00	82.00	89.00	89.00	89.00		
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00		
MAX CYL HEAD TEMP	DEG F	284.00	350.00	428.00	400.00	353.00		
EXHAUST GAS TEMP	DEG F	775.00	845.00	1475.00	1415.00	1420.00		
INDUCTION F/A RATIO (D)	LB/LB	0.13630	0.08409	0.10368	0.10359	0.07852		
IND. F/A EQUIV. RATIO	--	2.04	1.26	1.55	1.55	1.17		
ENGINE OBSERVED POWER	HP	0.11	0.17	0.43	0.39	0.33		
CBS BMEP	PSI	0.19	0.19	0.19	0.19	0.19		
CBS BSFC	LBM/BHP-HR	103.285	106.207	694.709	576.407	275.624		

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5
HC EMISSION RATE	LB/HR	1.35985	0.64202	3.64195	2.82287	0.93201
BRAKE SPECIFIC HC	LBM/BHP-HR	11.90320	3.74654	8.43366	7.26394	2.82289
HC MASS / MODE	LB	0.02266	0.11770	0.01821	0.23524	0.09320
CO EMISSION RATE	LB/HR	9.97434	17.73430	396.77856	288.47461	72.59288
BRAKE SPECIFIC CO	LBM/BHP-HR	87.30879	103.48952	918.81860	742.31689	219.87187
CO MASS / MODE	LB	0.16624	3.25129	1.98389	24.03955	7.25928
NOX EMISSION RATE	LB/HR	0.00240	0.01492	0.13881	0.14561	0.53961
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.02105	0.08707	0.32144	0.37468	1.63438
NOX MASS / MODE	LB	0.00004	0.00274	0.00069	0.01213	0.05396

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5
CAL. FUEL AIR RATIO	LB/LB	0.09080	0.09107	0.10373	0.10189	0.08302
DIFF. CALC & MEAS F/A	PERCENT	-33.38	8.31	0.04	-1.64	5.73
DIFF EV & CB RATE	PERCENT	0.05	1.19	0.05	0.05	0.92
SUM OF MOLE FRACTIONS		0.93658	1.04960	1.03584	1.03277	1.07575

GTSIO-520-K S/N 220015 TEST 15 BASELINE (20 DEG BTC) RUNS 172-178 05/13/76

PBARC	TCRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3	C - H FORMULA		PERCENT
29.858	79.00	75.00	2.1250	79.00	435.00	520.00	3.000	5.550	1.748

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	172.	173.	174.	175.	176.	177.	178.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.30	19.20	300.00	224.00	93.00	18.30	12.20	
INDUCTION AIR FLOW (W)	LB/HR	131.00	196.00	2947.00	2257.00	1173.00	230.00	131.00	
HYDROCARBON CONC.	PPM-C W	22500.00	5700.00	2130.00	2280.00	1605.00	6900.00	33750.00	
OXIDES OF NITROGEN CONC	PPM W	7.00	33.00	25.00	34.00	220.00	36.00	9.00	
CARBON MONOXIDE CONC.	PERCENT	9.15	9.80	13.50	12.95	7.80	8.80	7.95	
CARBON DIOXIDE CONC.	PERCENT	8.55	8.95	8.35	6.95	10.35	9.65	8.15	
OXYGEN CONC.	PERCENT	1.38	0.13	0.0	0.0	0.0	0.13	2.75	
WET CORRECTION FACTOR	--	0.85069	0.87259	0.85883	0.85614	0.83604	0.83604	0.85872	
PROP. TORQUE	FT-LB	40.00	98.00	891.00	787.00	487.00	95.00	45.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.00	13.50	44.50	36.50	24.00	12.60	14.30	
INDUCTION AIR TEMP	DEG F	80.00	80.00	85.00	85.00	83.00	83.00	83.00	
COOLING AIR TEMP	DEG F	91.00	90.00	88.00	89.00	88.00	85.00	86.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	310.00	370.00	428.00	400.00	350.00	295.00	333.00	
EXHAUST GAS TEMP	DEG F	725.00	860.00	1480.00	1415.00	1410.00	880.00	720.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09556	0.09970	0.10361	0.10101	0.08069	0.08098	0.09479	0.09342 TA
IND. F/A EQUIV. RATIO	--	1.43	1.49	1.55	1.51	1.21	1.21	1.42	1.40 TA
ENGINE OBSERVED POWER	HP	4.57	16.79	384.77	305.84	160.79	16.28	5.16	
OBS BMEP	PSI	7.73	18.95	172.26	152.15	94.15	18.37	8.70	
OBS BSFC	LBM/BHP-HR	2.692	1.143	0.780	0.732	0.578	1.124	2.373	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.56773	0.63372	3.30101	2.90014	0.95432	0.76821	2.34696	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.34307	0.03774	0.00858	0.00948	0.00594	0.04719	0.45653	
HC MASS / MODE	LB	0.02613	0.11618	0.01651	0.24168	0.09543	0.03841	0.03912	0.57345
HC MASS / RATED HP	LB/HP								0.00132
HC - PERCENT OF EPA STANDARD									69.38
CO EMISSION RATE	LB/HR	10.94877	19.19325	362.74121	284.69922	78.27563	16.53586	9.58374	
BRAKE SPECIFIC CO	LBM/BHP-HR	2.39596	1.14289	0.94276	0.93088	0.48683	1.01575	1.86421	
CO MASS / MODE	LB	0.18248	3.51876	1.81371	23.72493	7.82756	0.82679	0.15973	38.05394
CO MASS / RATED HP	LB/HP								0.08748
CO - PERCENT OF EPA STANDARD									208.29
NOX EMISSION RATE	LB/HR	0.00162	0.01217	0.12847	0.14341	0.43376	0.01329	0.00208	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00035	0.00072	0.00033	0.00047	0.00270	0.00082	0.00040	
NOX MASS / MODE	LB	0.00003	0.00223	0.00064	0.01195	0.04338	0.00066	0.00003	0.05893
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.03
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09608	0.09222	0.09829	0.10169	0.08473	0.08999	0.09520	0.09238 TA
DIFF. CALC & MEAS F/A	PERCENT	0.54	-7.51	-5.13	0.67	5.00	11.12	0.43	-1.11 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.76	1.85	0.05	
SUM OF MOLE FRACTIONS		1.05734	1.02057	1.12082	1.03624	1.07403	1.11852	1.05058	

GTSIO-520-K S/N 220015 TEST 16 BASELINE (20 DEG BTC) RUNS 179-185 05/13/76

PBARC	TORY	TWET	FUEL HYDROGEN-	TAMB	RATED	CID	EXHAUST	H2O IN AIR
IN HG ABS	DEG F	DEG F	CARBON RATIO	DEG F	HP	INCH**3	C - H FORMULA	PERCENT
29.913	79.00	75.00	2.1250	79.00	435.00	520.00	3.000 5.550	1.748

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	179.	180.	181.	182.	183.	184.	185.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.20	19.20	300.00	220.00	92.00	18.80	11.80	
INDUCTION AIR FLOW (W)	LB/HR	125.00	210.00	2960.00	2260.00	1180.00	215.00	125.00	
HYDROCARBON CONC.	PPM-C W	20700.00	9000.00	2160.00	2235.00	1605.00	6000.00	30000.00	
OXIDES OF NITROGEN CONC	PPM W	10.00	32.00	27.50	37.00	230.00	37.00	9.00	
CARBON MONOXIDE CONC.	PERCENT	8.15	9.70	13.30	12.80	7.45	8.80	8.25	
CARBON DIOXIDE CONC.	PERCENT	9.15	5.05	6.80	7.10	10.45	9.65	8.35	
OXYGEN CONC.	PERCENT	1.25	0.25	0.0	0.0	0.0	0.13	2.25	
WET CORRECTION FACTOR	--	0.87457	0.84566	0.86030	0.85108	0.83604	0.84228	0.86011	
PROP. TORQUE	FT-LB	46.00	103.00	903.00	799.00	498.00	110.00	40.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.50	13.50	44.50	36.50	24.00	13.00	14.90	
INDUCTION AIR TEMP	DEG F	81.00	81.00	85.00	85.00	84.00	83.00	84.00	
COOLING AIR TEMP	DEG F	83.00	81.00	88.00	88.00	87.00	83.00	84.00	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	276.00	336.00	429.00	390.00	347.00	330.00	343.00	
EXHAUST GAS TEMP	DEG F	725.00	870.00	1490.00	1420.00	1420.00	900.00	695.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09934	0.09306	0.10315	0.09908	0.07935	0.08900	0.09608	0.09115 TA
IND. F/A EQUIV. RATIO	--	1.49	1.39	1.54	1.48	1.19	1.33	1.44	1.36 TA
ENGINE OBSERVED POWER	HP	5.26	17.65	389.95	310.50	164.42	18.85	4.57	
CBS BMEP	PSI	8.89	19.91	174.58	154.47	96.28	21.27	7.73	
CBS BSFC	LBM/BHP-HR	2.322	1.088	0.769	0.709	0.560	0.997	2.582	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.43949	1.01107	3.62867	2.80925	0.95710	0.68519	2.00874	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.27392	0.05728	0.00931	0.00905	0.00582	0.03635	0.43958	
HC MASS / MODE	LB	0.02399	0.18536	0.01814	0.23410	0.09571	0.03426	0.03348	0.62505
HC MASS / RATED HP	LB/HP								0.00144
HC - PERCENT OF EPA STANDARD									75.63
CO EMISSION RATE	LB/HR	10.00639	18.60330	388.04395	276.42749	74.98134	17.08781	9.59171	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.90411	1.05399	0.99512	0.89026	0.45604	0.90652	2.09899	
CO MASS / MODE	LB	0.16677	3.41060	1.94022	23.03561	7.49813	0.85439	0.15986	37.06557
CO MASS / RATED HP	LB/HP								0.08521
CO - PERCENT OF EPA STANDARD									202.88
NOX EMISSION RATE	LB/HR	0.00231	0.01192	0.15319	0.15421	0.45480	0.01401	0.00200	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00044	0.00068	0.00039	0.00050	0.00277	0.00074	0.00044	
NOX MASS / MODE	LB	0.00004	0.00219	0.00077	0.01285	0.04548	0.00070	0.00003	0.06205
NOX MASS / RATED HP	LB/HP								0.00014
NOX- PERCENT OF EPA STANDARD									9.51
** DATA VALICITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09245	0.09325	0.10274	0.10090	0.08399	0.08946	0.09530	0.09235 TA
DIFF. CALC & MEAS F/A	PERCENT	-6.93	0.21	-0.40	1.84	5.84	0.52	-0.81	1.31 TA
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.90	0.05	0.05	
SUM OF MOLE FRACTIONS		1.02540	1.05373	1.03664	1.04325	1.07204	1.04989	1.04734	

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GTSIO-520-K S/N 220015 TEST 17 LEANOUT (20 DEG BTC) RUNS 186-192 06/04/76

PBARC	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA	H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3		PERCENT
29.982	82.00	74.50	2.1250	82.00	435.00	520.00	3.000 5.550	1.638

	UNITS	MODE 1	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2
RUN NUMBER	--	186.	187.	188.	189.	190.	191.	192.
TIME IN MODE	MINUTES	1.00	1.00	1.00	1.00	11.00	11.00	11.00
FUEL FLOW	LB/HR	12.20	10.80	9.90	9.60	18.80	17.10	15.80
INDUCTION AIR FLOW (W)	LB/HR	118.00	108.00	115.00	120.00	205.00	205.00	205.00
HYDROCARBON CONC.	PPM-C W	19500.00	12000.00	10500.00	14700.00	6900.00	6000.00	5400.00
OXIDES OF NITROGEN CONC	PPM W	7.50	17.50	23.00	27.00	27.50	50.00	62.50
CARBON MONOXIDE CONC.	PERCENT	8.55	6.80	5.95	2.80	9.65	8.15	5.35
CARBON DIOXIDE CONC.	PERCENT	8.85	10.15	10.60	11.20	8.80	9.75	11.20
OXYGEN CONC.	PERCENT	1.25	0.75	0.80	2.13	0.13	0.13	0.13
WET CORRECTION FACTOR	--	0.89431	0.90462	0.86628	0.88919	0.85118	0.83785	0.83785
PROP. TORQUE	FT-LB	40.00	46.00	43.00	39.00	95.00	109.00	98.00
PROP. SPEED	RPM	600.00	600.00	600.00	600.00	900.00	900.00	900.00
MFLD. PRESSURE	IN HG ABS DRY	14.20	13.80	14.00	14.50	12.90	13.20	13.00
INDUCTION AIR TEMP	DEG F	81.00	82.00	83.00	84.00	84.00	85.00	85.00
COOLING AIR TEMP	DEG F	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COOLING AIR DELTA P	IN H2O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX CYL HEAD TEMP	DEG F	265.00	338.00	364.00	296.00	323.00	379.00	350.00
EXHAUST GAS TEMP	DEG F	720.00	750.00	715.00	760.00	865.00	850.00	885.00
INDUCTION F/A RATIO (D)	LB/LB	0.10511	0.10167	0.08752	0.08133	0.09323	0.08480	0.07836
IND. F/A EQUIV. RATIO	--	1.57	1.52	1.31	1.22	1.39	1.27	1.17
ENGINE OBSERVED POWER	HP	4.57	5.26	4.91	4.46	16.28	18.68	16.79
OBS BMEP	PSI	7.73	8.89	8.31	7.54	18.37	21.07	18.95
OBS BSFC	LBM/BHP-HR	2.670	2.055	2.015	2.155	1.155	0.915	0.941

CARBON BALANCE MASS EMISSIONS

	UNITS	MODE 1	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2
HC EMISSION RATE	LB/HR	1.33197	0.76851	0.66234	0.99403	0.77575	0.64491	0.58063
BRAKE SPECIFIC HC	LBM/BHP-HR	0.29148	0.14624	0.13483	0.22310	0.04765	0.03453	0.03457
HC MASS / MODE	LB	0.02220	0.01281	0.01104	0.01657	0.14222	0.11823	0.10645
CO EMISSION RATE	LB/HR	10.54383	7.95306	6.56378	3.39877	18.64273	14.81698	9.73008
BRAKE SPECIFIC CO	LBM/BHP-HR	2.30734	1.51339	1.33616	0.76284	1.14516	0.79326	0.57939
CO MASS / MODE	LB	0.17573	0.13255	0.10940	0.05665	3.41783	2.71645	1.78385
NOX EMISSION RATE	LB/HR	0.00170	0.00372	0.00481	0.00605	0.01025	0.01782	0.02228
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00037	0.00071	0.00098	0.00136	0.00063	0.00095	0.00133
NOX MASS / MODE	LB	0.00003	0.00006	0.00008	0.00010	0.00188	0.00327	0.00409

** DATA VALIDITY CHECKS FOR ENG107 **

	UNITS	MODE 1	MODE 1	MODE 1	MODE 1	MODE 2	MODE 2	MODE 2
CAL. FUEL AIR RATIO	LB/LB	0.09282	0.08569	0.08292	0.07404	0.09305	0.08822	0.08107
DIFF. CALC & MEAS F/A	PERCENT	-11.70	-15.72	-5.26	-8.97	-0.20	4.02	3.46
DIFF EV & CB RATE	PERCENT	0.05	0.05	0.05	0.05	0.05	0.31	0.25
SUM OF MOLE FRACTIONS		1.00626	0.97181	1.00932	0.96566	1.03009	1.04735	1.02347

GTSIO-520-K S/N 220015 TEST 17A LEANOUT (20 DEG BTC) RUN 193 06/04/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.982	82.00	74.50	2.1250	82.00	435.00	520.00	3.000	5.550	1.630

	UNITS	MODE 2	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0	MODE 0
RUN NUMBER	--	193.						
TIME IN MODE	MINUTES	11.00						
FUEL FLOW	LB/HR	14.70						
INDUCTION AIR FLOW (W)	LB/HR	205.00						
HYDROCARBON CONC.	PPM-C W	5625.00						
OXIDES OF NITROGEN CONC	PPM W	80.00						
CARBON MONOXIDE CONC.	PERCENT	4.45						
CARBON DIOXIDE CONC.	PERCENT	11.75						
OXYGEN CONC.	PERCENT	0.13						
WET CORRECTION FACTOR	--	0.83785						
PROP. TORQUE	FT-LB	100.00						
PROP. SPEED	RPM	900.00						
MFLD PRESSURE	IN HG ABS DRY	13.30						
INDUCTION AIR TEMP	DEG F	85.00						
COOLING AIR TEMP	DEG F	0.0						
COOLING AIR DELTA P	IN H2O	0.0						
MAX CYL HEAD TEMP	DEG F	385.00						
EXHAUST GAS TEMP	DEG F	900.00						
INDUCTION F/A RATIO (D)	LB/LB	0.07290						
IND. F/A EQUIV. RATIO	--	1.09						
ENGINE OBSERVED POWER	HP	17.14						
OBS BMEP	PSI	19.33						
OBS BSFC	LBM/BHP-HR	0.858						
CARBON BALANCE MASS EMISSIONS								
HC EMISSION RATE	LB/HR	0.57350						
BRAKE SPECIFIC HC	LBM/BHP-HR	0.03347						
HC MASS / MODE	LB	0.10514						
CO EMISSION RATE	LB/HR	7.67401						
BRAKE SPECIFIC CO	LBM/BHP-HR	0.44782						
CO MASS / MODE	LB	1.40690						
NOX EMISSION RATE	LB/HR	0.02705						
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00158						
NOX MASS / MODE	LB	0.00496						
** DATA VALIDITY CHECKS FOR ENG107 **								
CAL. FUEL AIR RATIO	LB/LB	0.07907						
DIFF. CALC & MEAS F/A	PERCENT	8.46						
DIFF EV & CB RATE	PERCENT	1.34						
SUM OF MOLE FRACTIONS		1.05763						

GTSIO-520-K S/N 220015 TEST 18 BASELINE (SONIC VENTURI BLOCKED) 06/04/76

PBARO	TDRY	TWET	FUEL HYDROGEN-CARBON RATIO	TAMB	RATED	CID	EXHAUST C - H FORMULA		H2O IN AIR
IN HG ABS	DEG F	DEG F		DEG F	HP	INCH**3			PERCENT
29.959	80.00	73.00	2.1250	80.00	435.00	520.00	3.000	5.550	1.560

	UNITS	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TOTAL
RUN NUMBER	--	194.	195.	196.	197.	198.	199.	200.	
TIME IN MODE	MINUTES	1.00	11.00	0.30	5.00	6.00	3.00	1.00	27.30
FUEL FLOW	LB/HR	12.20	18.90	297.00	216.00	92.00	18.30	12.10	
INDUCTION AIR FLOW (W)	LB/HR	130.00	220.00	2965.00	2250.00	1170.00	220.00	130.00	
HYDROCARBON CONC.	PPM-C W	27000.00	7800.00	2175.00	2070.00	1575.00	5625.00	28500.00	
OXIDES OF NITROGEN CONC	PPM W	9.00	27.50	30.00	44.00	280.00	33.50	5.00	
CARBON MONOXIDE CONC.	PERCENT	8.25	10.40	13.20	12.60	7.25	8.40	8.90	
CARBON DIOXIDE CONC.	PERCENT	8.45	8.55	6.80	7.20	10.55	9.75	8.20	
OXYGEN CONC.	PERCENT	2.50	0.38	0.13	0.13	0.0	0.25	1.88	
WET CORRECTION FACTOR	--	0.86991	0.83915	0.86084	0.85198	0.83915	0.83915	0.84792	
PROP. TORQUE	FT-LB	45.00	102.00	905.00	805.00	485.00	94.00	42.00	
PROP. SPEED	RPM	600.00	900.00	2268.00	2041.00	1734.00	900.00	600.00	
MFLD PRESSURE	IN HG ABS DRY	14.00	13.30	44.50	36.50	24.00	12.80	14.20	
INDUCTION AIR TEMP	DEG F	80.00	80.00	85.00	84.00	83.00	82.00	82.00	
COOLING AIR TEMP	DEG F	0.0	0.0	89.00	89.00	88.00	0.0	0.0	
COOLING AIR DELTA P	IN H2O	0.0	0.0	4.00	4.00	4.00	0.0	0.0	
MAX CYL HEAD TEMP	DEG F	248.00	352.00	435.00	397.00	355.00	238.00	295.00	
EXHAUST GAS TEMP	DEG F	705.00	835.00	1460.00	1425.00	1420.00	860.00	700.00	
INDUCTION F/A RATIO (D)	LB/LB	0.09533	0.08727	0.10176	0.09752	0.07988	0.08450	0.09455	0.08794 TA
IND. F/A EQUIV. RATIO	--	1.43	1.31	1.52	1.46	1.20	1.26	1.41	1.32 TA
ENGINE OBSERVED POWER	HP	5.16	17.48	390.81	312.83	160.13	16.11	4.80	
CBS BMEP	PSI	8.70	19.72	174.97	155.63	93.77	18.17	8.12	
CBS BSFC	LBM/BHP-HR	2.373	1.081	0.760	0.690	0.575	1.136	2.522	
CARBON BALANCE MASS EMISSIONS									
HC EMISSION RATE	LB/HR	1.87461	0.86640	3.63262	2.56710	0.94115	0.63902	1.94874	
BRAKE SPECIFIC HC	LBM/BHP-HR	0.36465	0.04957	0.00930	0.00821	0.00588	0.03967	0.40614	
HC MASS / MODE	LB	0.03124	0.15884	0.01816	0.21392	0.09412	0.03195	0.03248	0.58072
HC MASS / RATED HP	LB/HP								0.00133
HC - PERCENT OF EPA STANDARD									70.26
CO EMISSION RATE	LB/HR	10.05915	19.56972	383.12769	268.75537	73.39148	16.16583	10.41693	
BRAKE SPECIFIC CO	LBM/BHP-HR	1.95669	1.11961	0.98034	0.85910	0.45833	1.00358	2.17102	
CO MASS / MODE	LB	0.16765	3.58778	1.91564	22.39627	7.33915	0.80829	0.17362	36.38838
CO MASS / RATED HP	LB/HP								0.08365
CO - PERCENT OF EPA STANDARD									199.17
NOX EMISSION RATE	LB/HR	0.00207	0.01013	0.16615	0.18094	0.55481	0.01262	0.00113	
BRAKE SPECIFIC NOX	LBM/BHP-HR	0.00040	0.00058	0.00043	0.00058	0.00346	0.00078	0.00024	
NOX MASS / MODE	LB	0.00003	0.00186	0.00083	0.01508	0.05548	0.00063	0.00002	0.07393
NOX MASS / RATED HP	LB/HP								0.00017
NOX- PERCENT OF EPA STANDARD									11.33
** DATA VALIDITY CHECKS FOR ENG107 **									
CAL. FUEL AIR RATIO	LB/LB	0.09220	0.09434	0.10194	0.09953	0.08349	0.08792	0.09772	0.09233 TA
DIFF. CALC & MEAS F/A	PERCENT	-3.28	8.10	0.18	2.06	4.52	4.04	3.35	4.99 TA
DIFF EV & CB RATE	PERCENT	0.05	0.98	0.05	0.05	0.67	0.42	0.05	
SUM OF MOLE FRACTIONS		1.05423	1.09657	1.03999	1.04779	1.06201	1.06371	1.05960	

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APPENDIX H. FUEL SAMPLE ANALYSIS

FUEL SAMPLE ANALYSIS

With the exception of the original O-200-A test runs, all emissions testing was done using Chevron 100 LL (ASTM 910-75) Avgas supplied by the Standard Oil Refinery in Pascagoula, Mississippi. Each fuel batch received at TCM is analyzed for specific gravity, distillation curve, tetraethyl lead content and vapor pressure, and records are maintained in the TCM Quality Control Lab.

In the original O-200-A testing, 80/87 octane fuel was used (ASTM 910-75) and subsequently, during the O-200-A re-test, 100 LL was used due to the unavailability of the 80/87. It is not expected that the substitution of this fuel would have an impact on the measured exhaust emissions from this engine.

In addition to the normal quality control fuel sample analysis, two special analyses were made of the atomic hydrogen-to-carbon ratio of the fuel used during testing. The two samples showed H-C ratios of the fuel to be 2.115 and 2.119. The results of the first analysis are presented as Figure H-1 of this Appendix. The results of the second analysis in November, 1976, by the Standard Oil Refinery were received by phone.

The H-C ratio of 2.125 based on an average fuel molecule, $C_8 H_{17}$, which was originally adopted for calculation purposes was retained when it was shown that fairly wide variations in H-C ratio had an insignificant effect on calculated mass emission rates.

HARRY W. GALBRAITH, PH.D.
PRESIDENT

GAIL R. HUTCHENS
EXECUTIVE VICE-PRESIDENT

VELMA M. RUSSELL
SEC.-TREASURER

GALBRAITH
Laboratories, Inc.

P. O. BOX 4187
2323 SYCAMORE DR.

QUANTITATIVE ORGANIC MICROANALYSES
KNOXVILLE, TENNESSEE 37921

PHONE 546-1335
AREA CODE 615

Mr. B. J. Rezy
Teledyne Continental Motors
P. O. Box 90
Mobil, Alabama 36601

February 5, 1975

Received: January 29th

Dear Mr. Rezy:

Analysis of your compound gave the following results:

Your #,	Our #,	% C,	% H,
100/130 Octane	R-7261	84.74	15.04

We regret that we were unable to determine the molecular weight because of the volatility of the sample.

Sincerely yours,

GALBRAITH LABORATORIES, INC.

Harry W. Galbraith

Harry W. Galbraith
President

HWG:rak

RECEIVED
Teledyne Continental Motors
FEB 7 1975
Aeronautical Engineering Department

FIGURE H-1

APPENDIX I. TEST CELL AND EMISSIONS MEASUREMENT SYSTEM SCHEMATICS

KEY TO FIGURE I-1. TEST CELL SCHEMATIC

1. Main fuel tank vent.
2. Main fuel tank.
3. Electric fuel pump (outlet pressure, 20 psig).
4. Fuel filter.
5. Cox Rotameter flowmeter (0 - 400 pph).
6. Engine priming system bypass solenoid.
7. Engine priming system bypass fuel line.
8. Fuel pressure regulator (outlet pressure, 5 psig).
9. Fuel float chamber.
10. Float chamber vent.
11. Fuel filter.
12. Fuel feed line to engine driven fuel pump.
13. Engine fuel pump bypass return line.
14. Cooling air shroud.
15. Cooling air mass flow measurement venturi.
16. Cooling air regulating valve.
17. Cooling air blower.
18. Induction air blower.
19. Induction air regulating valve.
20. Induction air filter.
21. Meriam laminar air flow meter.
22. Exhaust gas collector.
23. Exhaust sample probe.
24. Heated sample pump.
25. Heated sample line.
26. Lebow torque meter.
27. Constant speed propeller.

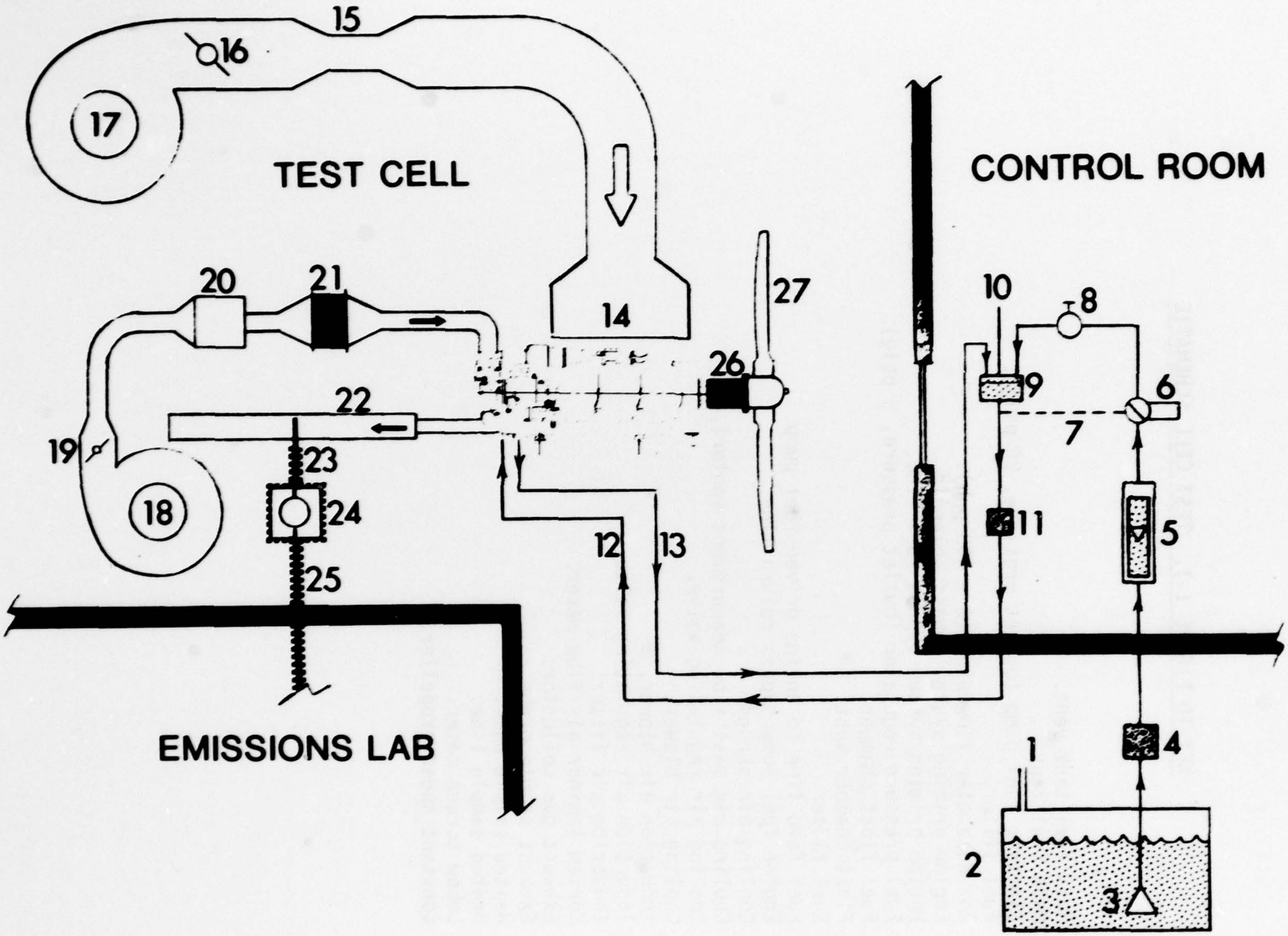

FIGURE I-1. TEST CELL SCHEMATIC

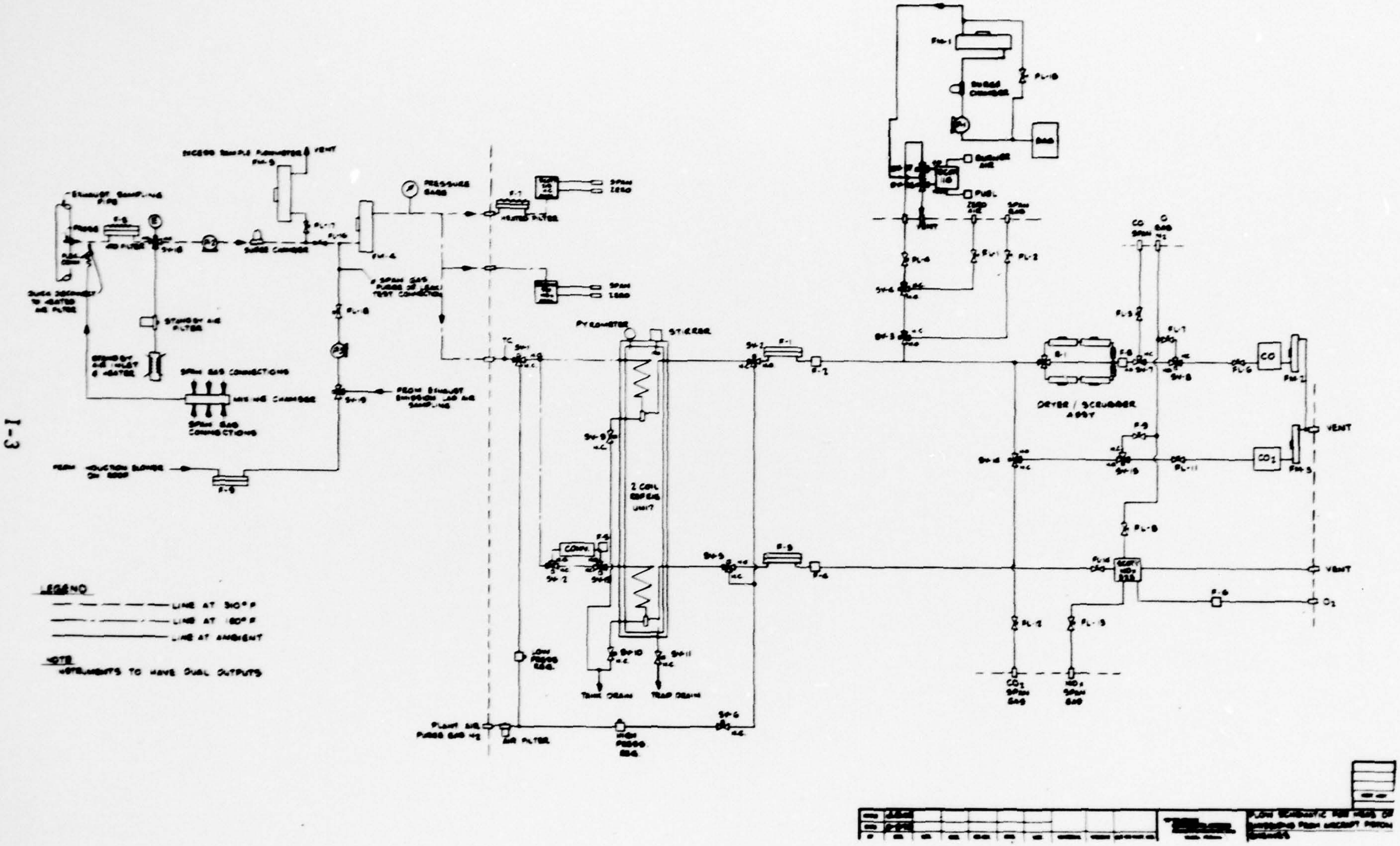

FIGURE I-2. EMISSIONS MEASUREMENT SYSTEM SCHEMATIC

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